

OA0/LST SHUTTLE ECONOMICS STUDY

Prepared for

National Aeronautics and Space Administration
Goddard Space Flight Center

Contract NAS5-17149

October, 1970

by

GRUMMAN AEROSPACE CORPORATION

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Volume II

Appendix to

OAQ/LST SHUTTLE ECONOMICS STUDY

Prepared by

GRUMMAN AEROSPACE CORPORATION

for

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

GODDARD SPACE FLIGHT CENTER

CONTRACT NAS 5 17149

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OA0/LST SHUTTLE ECONOMICS STUDY

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PROPOSAL FOR AN
OAO/IST SHUTTLE ECONOMIC STUDY

Submitted

to the

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Goddard Space Flight Center
Greenbelt, Maryland 20771

In Response to

RFP NO. 16067/575

By

GRUMMAN AEROSPACE CORPORATION
Bethpage, New York ,

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INTRODUCTION

The Grumman Aerospace Corporation is pleased to respond to the Goddard Space Flight Center Request for Proposal, N16067/575 dated 30 June 1970 for an OAO/LST Shuttle Economic Study.

The objectives of this study are two fold. The first objective is to determine the effect of utilizing the Space Shuttle upon the cost of the OAO/LST point design spacecraft. The second objective is to determine the effects of utilization of the Space Shuttle upon the mission objectives and operational system of the OAO/LST spacecraft.

Our proposal to undertake this study is based on our unique experience in being able to provide the major program elements involved in this effort in a timely fashion to result in a meaningful output.

This study will involve as one major program element the generation of a complete cost model of an OAO/LST based on the GSFC point design spacecraft and launched in what has been considered until now the conventional manner employing an expendable booster, the Titan III-C. Early in the concept development phase of the GSFC Program for the Large Space Telescope Grumman contributed to the structural and thermal configuration of this point design. This baseline cost model will undergo several iterations based on possible changes resulting from the introduction of the concept of an Earth Orbital Shuttle (EOS) available for initial launch, deployment, resupply, and retrieval. The effects of this EOS availability on the design and operation of the OAO/LST spacecraft and the resultant sensitivity to program costs will be presented.

Grumman also has considerable experience in another major study program element - the Earth Orbital Shuttle. We recently competed successfully for a study of several alternate designs after more than 2 years of dedicated effort on the part of several hundred people at Grumman who were involved in the evaluation of Earth Orbital Shuttle Concepts. We propose to draw heavily on this experience for this OAO/LST Economic Study.

Another major program element, which has received little attention in the past, is the Teleoperator device which forms the major interface between the shuttle and spacecraft. Grumman is in a unique position to make a major contribution in this area since it has been involved in the design and evaluation of remote manipulator type devices. These type of devices are employed in the Grumman built deep submersible vehicle, the Ben Franklin. The design experience and actual operational data available from the GAC Ocean Systems Program will be a major source of information for our study team members to draw upon in considering Teleoperator requirements.

An especially significant program element of this study will be credible cost data. To this end Grumman will rely heavily on the cost data available from the present OAO Program which provides a continuous ten year history of cost.

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To augment our OAO Program cost history we have also had wide experience in the design, development, and production of large and complex structures, many involving the use of the latest exotic materials technology. This familiarity with requirements and costs will be applied to the cost models in the OAO/IST Economic Study.

An additional interface requirement is the evaluation of the influence of man rated systems on the design of the IST and a comparison of costs associated with man rating on the program. GAC will rely on our LM experience for this area of the study.

In summary, GAC has been familiar with and in many cases a direct participant in the major factors contributing to this OAO/IST Economic Study. Unique experience in these critical areas assures a straightforward approach to the evaluation of the baseline cost model and satisfactory development of interface requirements and definition of the resulting costs for the timely execution of this study.

Part 1 of this proposal is the study guidelines and constraints. Part 2 is the Shuttle Interface considerations with the statement of work and the task Flow Diagram in Parts 3 and 4. Part 5 is the Proposed Schedule. Part 6 contains the cost and pricing summary and financial information.

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GAO/LST SHUTTLE ECONOMIC STUDY

PART 1

STUDY GUIDELINES AND CONSTRAINTS

1. GSFC/LST point design to be used as baseline definition of observatory (Space Vehicle) hardware elements. This is defined in the following documentation:

1. STAR Presentation
2. Structural Designs for a 120-inch Diameter Advanced Orbiting Telescope
X-284-70-147
April 1970
3. Additional material to be supplied

2. Shuttle launch vehicle capabilities model to be supplied by GAC Shuttle Group (W. Carl is Shuttle interfaces representative on study team) typical shuttle launch and servicing costs to be supplied by GAC Ops Anal.

Note: The 25,000# LST plus handling, servicing and interface equipment will be assumed to be capable of being inserted into a 400 ft. long, vertical shaft, 35° inclination limit as required.

3. GSFC/LST mission model as described in the STAR presentation referenced above will be used.

Note: The intent of this mission model is to provide up to 90 to 100% observing time availability to orbital astronomy. The actual mission model required to accomplish this goal is to be determined by the GAC Study.

4. The Titan III D (or equivalent Titan Model designation) Expendable Launch Vehicle with a stretched version of the Viking Centaur Shroud (Fairing) will be used as the model for the baseline costing. The Launch environments and payload constraints of this vehicle will be supplied by GAC/GSFC.
5. The LST-peculiar service module for automated resupply of the observatory will be as defined by GAC documentation to be supplied.

Note: 1) The intent of this mechanism is to minimize the costs of Man Rating Influences on the payload (LST) costs. Maintainability is to be limited to that which can be accomplished with the teleoperation system.

(See documents 4C and 5 for teleoperator references)

5. Continued

Note 2) EVA maintenance represents a possible alternative to the above service module which, if shown to be feasible, may result in lower LST program costs. Reference 2A, Page 2 states that this should be another study independent of the shuttle. We should consider the possibility of proposing such a study to be done as a follow-on to the present study. Present studies in the Reliab./Maint. section could provide background and justification for such a proposal.

6. Observatory checkout, alignment and calibration will be conducted through the GSFC Ground Station and Observatory Spacecraft telemetry link. No special equipment for this purpose is presently envisioned for the shuttle.

Note: The shuttle launch readiness cycle and payload injection operations may require some kind of payload readiness check-out. This requirement will be supplied by shuttle interface group.

7. The Shuttle launch vehicle environment imposed on the LST, due to re-entry and landing from an aborted mission should be considered part of the structural design requirements for the LST and its subsystems. It is intended that additional costs due to this requirement be identified if significant.
8. The Shuttle launch vehicle will be considered to be available for the LST program starting CY 1977 and as required by the STAR mission Workload thereafter.
9. Potential hazards created by the LST spacecraft when on-board the Shuttle should be reduced to a level to be determined by the shuttle interfaces group.

Note: A reference to "Category III b" of Safety Program Directive No. 1, Rev. A (SPD-1A)

- Systems Safety Requirements for Manned Space Flight, has been given as one guideline.

10. Shuttle capabilities for rendezvous, docking, and subsequent attitude stabilization and electrical power support of the docked configuration will be determined by the Shuttle Interfaces group.

11. Availability of a Data Relay Satellite System for continuous real-time communications between the observatory and the ground is not known this time. Advantages of DRSS will be listed but not costed.
12. Spacecraft systems failures should be categorized as: those capable of repair and replacement in orbit through automated procedures, and those requiring retrieval and ground repair. EVA activity will be considered as an alternate to retrieval only.
13. The Level of Modularity for Orbital resupply is assumed to be at the Sub-system Assembly Level as described in the STAR presentation.
14. Experiment Package replacement will be performed for two reasons:
 - 1) Experiment mission change - typically a one year mission duration is estimated for the particular experiment.
 - 2) Experiment equipment failure will require package replacement at the next scheduled shuttle visit. Since four independent experiments will be in the observatory payload, the loss of one would not cause loss of scientific mission.
15. The Observatory Spacecraft will be defined for the purposes of this study as being comprised of the following subsystems which include a number of separate modules.
 - 1) Stabilization and Control
 - 2) Communications
 - 3) Data Handling
 - 4) Electrical Power
 - 5) Structure
 - 6) Thermal
 - 7) Experiment
 - 8) Primary Optics
16. The shuttle launch mode is defined as including the phases of:
 - 0) Configure shuttle for dedicated IST mission
 - 1) Stacking in the shuttle payload bay
 - 2) Shuttle ground checkout and launch readiness cycle
 - 3) Shuttle launch
 - 4) Boost to orbit
 - 5) Orbital transfer (if required)
 - 6) Payload deployment including checkout
 - 7) Payload release

17. The Shuttle instrument update mode is defined as including the phases of:

- 0) Configure Shuttle for dedicated LST mission
- 1) Loading replacement experiment packages in the shuttle payload bay
- 2) As in 16
- 3) As in 16
- 4) As in 16
- 5) As in 16
- 6) Rendezvous with LST
- 7) Docking to LST
- 8) Service module and experiment package deployment
- 9) Experiment package replacement
- 10) Service module and old experiment package return and STOW
- 11) Shuttle return to earth

18. The shuttle refurbish (orbital) mode is defined identically with the instrument update mode with the substitution of "Subsystem Package" for "experiment package".

Note: Both instrument update and subsystem replacement can be performed simultaneously.

19. The shuttle retrieval mode is defined as including the following phases:

- 1) Shuttle Rendezvous with LST
- 2) LST Capture
- 3) LST return to STOW Configuration
- 4) LST STOW in shuttle
- 5) Shuttle return to Earth
- 6) LST unload from shuttle

20. LST has backup S&C System capable of putting LST in safehold mode for shuttle retrieval comprised of sun sensor, gyros and jets.

QAO/LST SHUTTLE ECONOMIC STUDY

PART 2

SHUTTLE INTERFACE CONSIDERATIONS

1. Shuttle guidelines and constraints are: Section A, Baseline System Requirements; Section B, Mission Requirements; and Section C, Desired System Characteristics.
2. Shuttle capabilities with regard to altitude and angle of inclination have been calculated and are compatible with the LST orbital requirements.
3. Interfaces:

a) Structural

1. It can be assumed that lateral and longitudinal support can be provided in 2 planes to avoid weight penalty of cantilevered support.
2. Deployment Retrieval - It can be assumed that EOS will provide deployment. Deployment should be translational until LST is outside cargo bay. Deployment mechanism will include a docking mechanism for capturing LST for servicing, module replacement, or return to earth.
3. Shrouding - LST can be transported to orbit within a pressurized module with thermal control or simply installed in the unpressurized bay.

b) Electrical

1. Electrical Power

Electrical Interface

Power available from Shuttle for use by payload:

Type:

D.C.	120 Volts (May become 28 volts)
A.C.	400 Cycles 120 Volts

Quantity:

500 watts available. More could be made available, if necessary.

Docking

Accelerations, assumed:

CONDITION	$N_x(g)$	$N_y(g)$	$N_z(g)$
Max. Accel	+3.0 -1.30	±1.0	+2.5 -2.7
Entry	-0.13	±0.1	-2.2
Landing	-1.30	±0.1	-2.7
Maneuver	-0.7	±1.0	±2.5
Rebound & Lift Off	+1.45	±0.5	±0.8

PARAMETER	BASELINE DESIGN
Miss Distance Centerline	±15 in
Miss Angle Centerline	±40°
Rotation Angle	±40°
Contact Velocity	0-0.5 ft/sec

SECTION ABASELINE SYSTEM REQUIREMENTS

The following characteristics shall be considered as baseline system requirements. Variations from these baseline requirements should be identified by the contractor in the event improvements in mission capability and/or reductions in cost could be achieved.

<u>Systems Requirements</u>	<u>Vehicle (B-Booster) (O-Orbiter)</u>
1. Fully Reusable Two (2) Stage Vehicle	B, O
2. Vertical Takeoff; Horizontal Landing	B, O
3. No propellant cross feed	B, O
4. Aerodynamic Crossrange: Configuration (s) for low crossrange (approximately 200 n.mi.) and high crossrange (approximately 1500 n.mi.)	O
5. Gross liftoff weight - 3.5 million pounds	B, O
6. The cargo bay shall be sized to have a clear volume of 15' diameter X 60' length.	O

<u>Systems Requirements</u>	<u>Vehicle (B-Booster) (O-Orbiter)</u>
7. A maximum payload capability shall be provided to the Space Station orbit and return. The vehicle must also be capable of flying up or down with lighter payloads.	0
8. 400,000 pound sea level thrust bell-type engines will be baselined in both the orbiter and booster stages as further defined in CEI Specifications, DCN 1-0-21-00001.	B, 0
9. Sequential Ignition	B, 0
10. Intact abort capability will be provided. This implies the capability of the booster and orbiter to separate and continue flight to a safe landing; the orbiter to land with a full payload.	B, 0
11. A Booster/Orbiter life of 100 missions will be provided with a cost effective level of refurbishment and maintenance.	B, 0
12. The weight of passengers and removable provisions for passengers is charged to the payload.	0
13. All vehicle stages shall be capable of ferry flights between airports; provisions for strap-on engines and/or auxiliary tankage may be considered.	B, 0
14. The Booster and Orbiter shall be baselined to have go-around capability.	B, 0
15. The Booster shall be capable of returning to the launch site.	B
16. The Booster and Orbiter shall each have a two (2) man flight crew.	B, 0
17. Propellant shall provide 1500 fps in excess of the amount required to obtain the referenced injection orbit. The tanks shall be sized to provide for a 2000 fps delta V capability.	0
18. The Orbiter crew and passenger environment shall be shirtsleeve.	0
19. Systems sensitivity to loading of fluid consumables shall be minimized.	B, 0

SECTION B
MISSION REQUIREMENTS

The following mission requirements are presented to provide initial direction for the Phase B Study. Continuous refinement of these requirements may be provided to the contractor by the NASA throughout the duration of the contract. Table B-1 contains a general description of the missions and mission requirements that have been identified as being of major interest in future space program planning.

The following nominal conditions have been selected, from the mission matrix discussed previously, as the shuttle baseline requirements:

1. Mission duration: At least 7 days of self-sustaining lifetime shall be provided for the mission duration. For missions in excess of 7 days the weight of the expendables shall be charged against the payload.
2. Design reference mission: The reference mission to be used in designing the space shuttle is a logistics resupply of a space station or space base.
3. Reference injection orbit. The reference injection orbit shall be 50 x 100 nautical miles.
4. Reference injection orbit V: 1500 fps of usable V capability in excess of the amount required to attain the reference injection orbit shall be provided.
5. Design reference orbit: The reference orbit to be used in designing the space shuttle shall be a 270-nautical mile circular orbit, with a 55° inclination. For purposes of performance calculation the vehicle shall be considered to be launched from a latitude of 28.5 degrees North.

TABLE B-1

MISSION CHARACTERISTICS

ORBITAL CHARACTERISTICS	MISSIONS	SPACE STATION/ BASE LOGISTICS SUPPORT	PLACEMENT AND RETRIEVAL OF SATELLITES	DELIVERY OF PROPULSIVE STAGES & PAYLOAD	DELIVERY OF PROPELLANTS	SATELLITE SERVICE & MAINTENANCE	SHORT DURATION ORB. MISSION
ALTITUDE (N. MI.)		200 - 300	100 - 800	100 - 200	200 - 300	100 - 800	100 - 300
INCLINATION (DEG.)		28.5-90	28.5-SUN SYN.	28.5-55	28.5-55	28.5-SUN SYN	28.5-90
ON-ORBIT V (1000 FPS)		1 - 2	1 - 5	1 - 1.5	1 - 2	1 - 5	1 - 2
ON-ORBIT STAY TIME (DAYS)		7	7	7	7	7 - 15	7 - 30
CREW		2	2	2	2	2	2
PASSENGERS		ROTATE 50 MEN/QTR	2	2	2	4	12
DISCRETIONARY PAYLOAD							
WEIGHT (1000 LBS.)		* 70/QTR	-----	-----	-----	-----	-----
VOLUME (1000 FT. ³)			5 - 10	10	10	5 - 10	4 - 6
CRITICAL DIMEN DIA. (FT.)		10 - 15	15	15	15	15	15

* INCLUDE PASSENGERS

SECTION C

DESIRED SYSTEM CHARACTERISTICS

The desired system characteristics listed below are presented to provide initial direction for the Phase B Study. The contractor shall evaluate these desired system characteristics and shall recommend revisions where improvements in cost and effectiveness would result. Continuous refinement of these characteristics will also be provided to the Contractor throughout the duration of this contract. For convenience, the following tabulation of characteristics has been grouped under three headings: Program Characteristics, Vehicle Characteristics, and Operational Characteristics; however, it should be noted that each item applies to the total system.

Program Characteristics

1. Costs will be reported using the design reference mission and should not include payload costs. A communication satellite system is assumed to be available and shall not be costed in the program.
2. The calendar year 1972 will be used as the materials technological base.
3. IOC baseline is the second half of 1977.
4. Flexibility shall be maintained to incorporate technology advancement and alternate missions.
5. Launch rates will vary from a minimum of 25 to a maximum of 75 per year. Cost estimates shall be developed for two launch rates: 25 and 75/year.

Vehicle Characteristics

Vehicle (B-Booster)
 (O-Orbiter)

1. The vehicle shall have a two-man flight crew and shall be flyable under emergency conditions by a single crewman.
2. Provisions shall be made for deployment and boarding of a cylindrical payload of the size specified in Appendix A of this document.

B, 0

0

<u>Vehicle Characteristics (Continued)</u>	<u>Vehicle (B-Booster) (O-Orbiter)</u>
3. The crew environment shall be shirt-sleeve.	B, 0
4. The space shuttle shall have an internal sealable tunnel with a standard interface between the crew compartment and unpressurized payload bay.	0
5. The space shuttle crew/passenger compartment atmosphere and total pressure shall be compatible with the space station and space base.	0
6. Systems shall be designed for a minimum of maintenance with ease of removal and replacement; maximum use of aircraft design practice will be used.	B, 0
7. In systems where redundancy is needed, the space shuttle systems shall be developed to provide redundant full mission capability and shall avoid minimum-requirement, minimum performance backup system concepts.	B, 0
8. The space shuttle system shall provide for safe mission termination in the event major malfunctions occur during prelaunch preparations and subsequent to lift-off. The desired safe-mission-termination capabilities should allow for crew and passenger egress prior to lift-off and for intact separation of orbiter from booster following lift-off.	B, 0
9. Multiple redundancy system techniques that minimize or eliminate system transients caused by system component failures shall be adopted.	B, 0
10. All subsystems shall be designed to fail operational after the failure of the most critical component and to fail safe for crew survival after the second failure. Electronic systems shall be designed to fail operational after failure of the two most critical components and to fail safe for crew survival after the third failure.	B, 0

Vehicle Characteristics (Continued)Vehicle (B-Booster)
(O-Orbiter)

- | | |
|---|------|
| 11. Boost stages should be designed for manned operations, but capable of operating in an unmanned mode. | B |
| 12. Vehicle preflight and inflight checkout systems should be on-board, consistent with short turn-around and low cost operations. | B, 0 |
| 13. The vehicle shall be designed for maximum on-board control, using on-board and ground capabilities as appropriate to maximize operational flexibility and minimize ground mission operations consistent with low cost. | B, 0 |
| 14. Guidance and navigation functions shall be performed on-board, using ground and other navigation aids when appropriate. The guidance and navigation system shall be unrestricted in attitude. | B, 0 |
| 15. A three-axis translation system and a three-axis attitude control system is required. These systems shall be designed to minimize cross coupling which may result from normal operation and from potential failure modes. | B, 0 |
| 16. The Booster and Orbiter shall be capable of Pilot Controlled Landing under FAA Category II Conditions. Autopilot Systems similar to Systems used on commercial aircraft shall be included. | B, 0 |
| 17. The vehicle shall incorporate on-board provisions to quickly and easily place the space shuttle in a safe condition following landing. | B, 0 |
| 18. Survivability against hazards from radiation as specified in Joint DOD/NASA Survivability Characteristics document (s) dated 16 June 1969. | 0 |
| 19. Hydrogen will be baselined as fuel for the air breathing engines. | B, 0 |

<u>Operational Characteristics</u>	<u>Vehicle (B-Booster)</u> <u>(O-Orbiter)</u>
1. Space Shuttle launch sites may be located at KSC, Western Test Range, or an in-land site.	B, 0
2. All-azimuth launch capability	B, 0
3. The vehicle trajectory load factors should be a 3g capability for passenger-carrying missions.	B, 0
4. The launch pad, the primary landing site, and the servicing facility shall be in the same general location.	B, 0
5. The space shuttle shall have minimal assembly and checkout requirements at the launch pad.	B, 0
6. Use of specialized facilities (ie, Clean Room, altitude chambers, etc.) shall be minimized).	B, 0
7. Cargo elements containing hazardous material shall have self-contained protective devices or provisions against all hazards.	0
8. A variety of self-sustaining payload types shall be included in the payload integration. Pre-launch payload integration procedures similar to current air-cargo carrier operations are desired. In general, payloads should be loaded prior to moving to the launch pad.	0
9. Limited transfer of cargo shall be possible through the personnel transfer hatch.	0
10. The vehicle shall be docked to the space station or space base, and docking to accommodate personnel and cargo transfer should nominally be accomplished in a single operation.	0
11. Personnel and cargo transfer shall nominally be intravehicular activity.	0
12. For logistics missions, personnel and cargo transfer will be by intravehicular activity. EVA capability should be provided at the expense of the allocated payload weight. The design of the vehicle should not preclude EVA capability.	B, 0

<u>Operational Characteristics (Continued)</u>	<u>Vehicle (B-Booster)</u> <u>(O-Orbiter)</u>
13. The space shuttle shall be designed to lift-off within a 60-second launch window for all launch azimuths.	B, O
14. For the design reference mission, the space shuttle shall be capable of launch from a standby status within two hours and nominally would be launched at the next acceptable in-plane opportunity. The vehicle should be capable of staying in a launch status until the second in-plane launch opportunity. The system must be capable of accommodating the time between insertion and rendezvous for a worst case phasing situation. The orbit maneuver sequence should not be constrained by systems limitations.	B, O
15. By using ground facilities and other aids when appropriate, the space shuttle shall be capable of accomplishing rendezvous with a passive target.	O
16. Systems sensitivity to weather conditions during assembly, checkout, and launch shall be minimized.	B, O
17. The opportunity to return to a pre-selected site shall be available at least once every 24 hours or at more frequent intervals for the high cross-range configuration. By using alternate sites, more frequent emergency returns will be possible.	O
18. Hypersonic lift-drag ratios will be referenced to conditions at a Mach number of 20 and at an altitude of 200,000 feet.	B, O
19. The space shuttle elements shall have the capability to land horizontally on runways no longer than 10,000 feet.	B, O
20. Landing characteristics and handling qualities shall not require skills more demanding than those required for operational land-based aircraft.	B, O

<u>Operational Characteristics (Continued)</u>	<u>Vehicle (B-Booster)</u> <u>(O-Orbiter)</u>
21. Visibility from the cockpit during landing shall be comparable to high-performance aircraft standards.	B, 0
22. Total space shuttle turn-around time from landing to launch readiness should be less than two weeks. The removal and replacement time shall be minimized with on-board checkout and module accessibility.	B, 0
23. All-electronic displays and control should be used, wherever practicable, to replace toggle switches and electromechanical gages and motors.	B, 0
24. The space shuttle shall be capable of operating within the cargo range from zero to maximum capability.	B, 0
25. Service lines at the launch pad should be minimal, preferably only for the main propulsion systems propellants.	B, 0
26. Maximum use of existing standards for the selection, design, packaging and integration of hardware should be employed, consistent with program operational requirements.	B, 0
27. Any peculiar GSE required to support a remote site landing should be packaged in a manner to be easily flown into the site.	B, 0

- 1.4.3 Expendable Launch Vehicle
 - Titan III
 - Vehicle Interface
 - Shroud
- 1.4.4 Ground Operations
 - Ground Control Station/Crew
 - Manned Operations Control/Crew
 - Facilities/Test, Handling Crew
- 1.5 Breakdown Major Cost Elements to Subsystem Hardware Level into:
 - 1.5.1 Direct cost hardware and develop recurring, non-recurring, refurbishment.
 - 1.5.2 Contribution to GSE, spares, major test hardware, final assembly test and checkout.
 - 1.5.3 Pro-rated costs of system engineering support, program management, G&A.
- 1.6 Establish Detailed Definition of Resupply or Service Modes to Include Launch, Instrument Update, Refurbish (Orbital), Test (Orbital), and Retrieval.
- 1.7 Define Functional, Hardware, and Operation Requirements Peculiar to OAO/LST Mission for:
 - 1.7.1 Observatory
 - 1.7.2 Shuttle
 - 1.7.3 Ground Station
- 1.8 Define Subsystem Hardware Level Requirements for Costing and Establish Preliminary Criteria with and without Maintenance and:
 - 1.8.1 Identify development items
 - Identify state-of-art items
 - Identify on-shelf items
 - Identify refurbish design requirements
 - Establish spares philosophy and identify cost impact
 - 1.8.2 Establish definition of cost validity (average, plus or minus tolerances).
 - 1.8.3 Rank cost factors in order of importance.

- 1.9 Establish Reliability-Maintainability Model Replaceable Modules using OAO Flight System Experience. Maintainability is Limited to that which can be accomplished with the Teleoperator System.

TASK GROUP 2

DETERMINE MAJOR COST DRIVERS, UTILIZING DEFINITIONS OF TASK 1 AND COST DATA FROM OAO, LM, AND SHUTTLE PROGRAM

- 2.1 Establish Preliminary Cost Model with and without Shuttle. Quantify and Rank Major Cost Elements for Each Model; Select Principle Cost Drivers.

- 2.2 Study and Quantify Cost Benefit Effects of Shuttle Serviceability on Hardware Cost Drivers in Each of Following Areas:

2.2.1 Design

- o Lower qualification requirements
- o Lower reliability requirements
- o Lower weight optimization requirements
- o Lower material performance requirements

2.2.2 Test and Checkout (Ground and In-Orbit)

- o Lower acceptance-test requirements
- o Lower test elements
- o Lower number of test articles
- o Determine alignment and calibration trade-offs for telescope

- 2.3 Study and quantify cost benefit effects of shuttle serviceability on Program Cost Drivers in each of following areas:

2.3.1 Schedules

- o Long lead items
- o Pacing items
- o Repair and turn-around

2.3.2 Facilities

- o Test
- o GSE
- o Shuttle Support Equipment
- o Spares Handling

2.3.3 Services (Manpower)

- o Engineering
- o Manufacture
- o Field Operations
- o Test

2.3.4 Spares

Shelf Life, Complement and Readiness

2.4 Expand Reliability - Maintenance Study

- Identify and rank wear-out items for each subsystem
- Determine expendables schedule
- Determine required reliability functional path (assume maintenance rate)
- Determine Reliability and Maintenance - Cost optimize approach for hardware in critical (costly) areas, e.g. level of redundancy vs. replacement.

2.5 Expand Experiment Package Definition Study for two Cost Categories. The first is the on-axis mission success package. The second is the principle investigators radial packages.

- Estimate replacement cycles rates based on scientific requirements
- Categorize generically physical characteristics for typical experiment types.
- Estimate typical experiment cost; original development and build.
- Estimate typical refurbishment and upgrade package cost
- Estimate special handling, hardware, test, alignment, calibration for orbital servicing

TASK GROUP 3

IDENTIFY AND EVALUATE COMPARITIVE COSTS FOR SELECTED PROGRAM OPTIONS

3.1 Assemble selected program options for cases with and without shuttle resupply

- o Evaluate feasibility of alternatives
- o Evaluate sensitivities of major cost drivers to program alternatives, varying parameters
- o Analyze effects of basic study assumptions on cost results.

3.2 Indicate best Reliability-Maintainability approach for design, manufacture, operation for each selected program - Determine logistics/spares rationale, each case.

3.3 Estimate manpower, materials, facilities, and related costs required to refurbish and recycle observatory.

- 3.4 Estimate development, build, test, training costs associated with automated servicing module - look at EVA/IVA alternative.
- 3.5 Summarize comparative costs for selected program options.

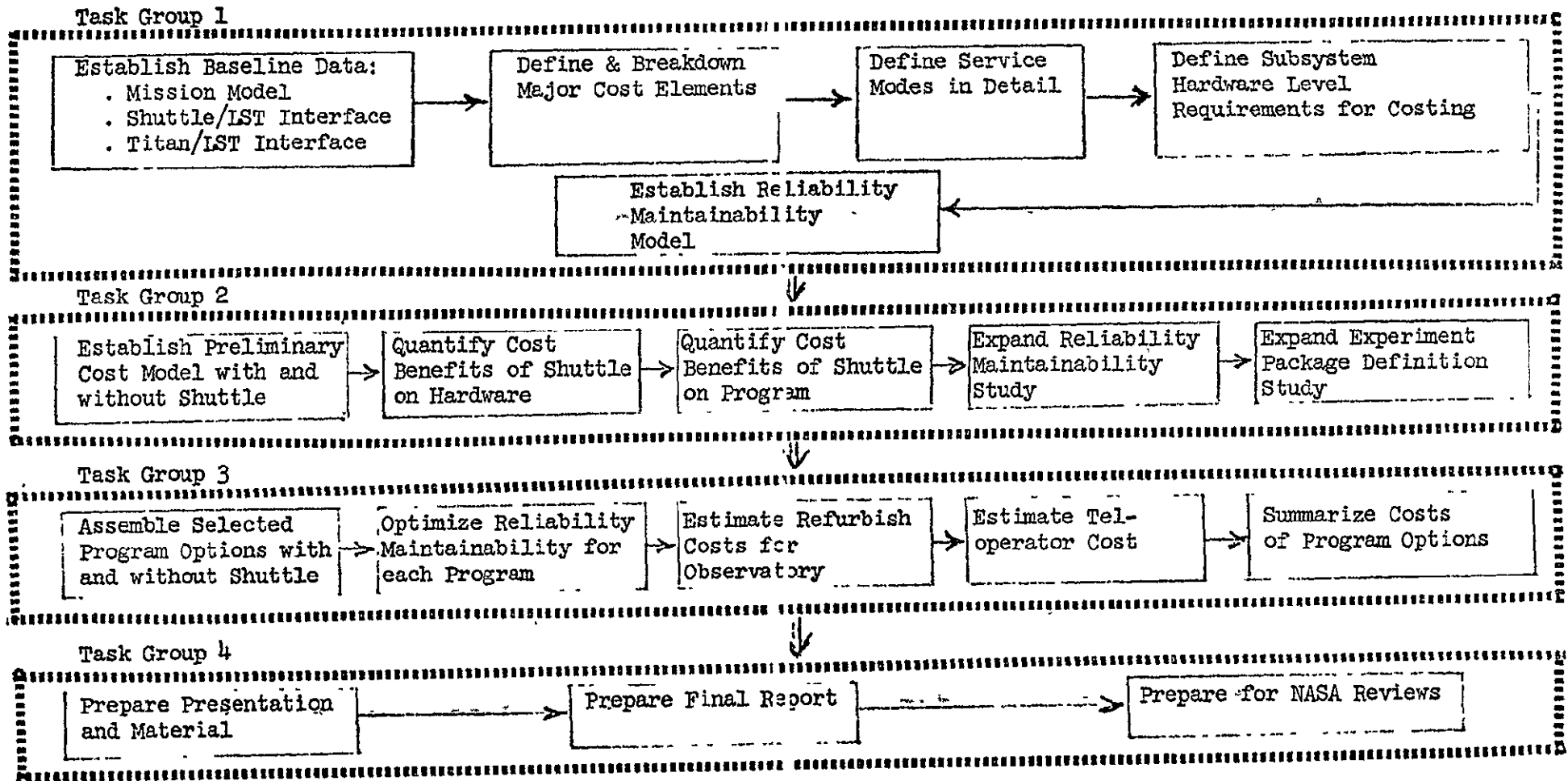
TASK GROUP 4

FINAL REPORT

- 4.1 Presentation of results - generate charts, graphs, etc. - prepare presentation.
- 4.2 Final Report - OAO/IST Shuttle Economics Study
- 4.3 NASA Reviews

OAO/LST SHUTTLE ECONOMIC STUDY

TASK FLOW DIAGRAM



Appendix Section 3
Reliability/Maintainability Outputs

Appendix Subsection 3A
Apportionment Computer Output Summary

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MTTF	DELAY TIME	NO. FAIL	UPTIME	UPTIME RATIO
3.0	0.5	48.00	144.0	0.79999995
3.0	1.0	42.00	126.0	0.69999999
3.0	1.5	37.33	112.0	0.62222230
3.0	2.0	33.60	100.8	0.56000006
3.0	2.5	30.55	91.6	0.50909108
3.0	3.0	28.00	84.0	0.46666664
3.0	6.0	18.67	56.0	0.31111115
3.0	12.0	11.20	33.6	0.18666667
3.0	24.0	6.22	18.7	0.10370380
6.0	0.5	25.85	155.1	0.86153841
6.0	1.0	24.00	144.0	0.79999995
6.0	1.5	22.40	134.4	0.74666667
6.0	2.0	21.00	126.0	0.69999999
6.0	2.5	19.76	118.6	0.65882373
6.0	3.0	18.67	112.0	0.62222236
6.0	6.0	14.00	84.0	0.46666664
6.0	12.0	9.33	56.0	0.31111115
6.0	24.0	5.60	33.6	0.18666673
9.0	0.5	17.68	159.2	0.89421053
9.0	1.0	16.80	151.2	0.84000003
9.0	1.5	16.00	144.0	0.79999995
9.0	2.0	15.27	137.5	0.76363641
9.0	2.5	14.61	131.5	0.73043483
9.0	3.0	14.00	126.0	0.69999999
9.0	6.0	11.20	100.8	0.56000000
9.0	12.0	8.00	72.0	0.39999998
9.0	24.0	5.09	45.8	0.25454545
12.0	0.5	13.44	161.3	0.89599997
12.0	1.0	12.92	155.1	0.86153841
12.0	1.5	12.44	149.3	0.82962966
12.0	2.0	12.00	144.0	0.79999995
12.0	2.5	11.59	139.0	0.77241379
12.0	3.0	11.20	134.4	0.74666667
12.0	6.0	9.33	112.0	0.62222230
12.0	12.0	7.00	84.0	0.46666664
12.0	24.0	4.67	56.0	0.31111115
15.0	0.5	10.94	162.6	0.90322578
15.0	1.0	10.50	157.5	0.87500000
15.0	1.5	10.18	152.7	0.84848475
15.0	2.0	9.88	148.2	0.82352942
15.0	2.5	9.60	144.0	0.80000007
15.0	3.0	9.33	140.0	0.77777785
15.0	6.0	8.00	120.0	0.66666663
15.0	12.0	6.22	93.3	0.51851857
15.0	24.0	4.31	64.6	0.35974466
18.0	0.5	9.08	163.5	0.90810806
18.0	1.0	8.84	159.2	0.88421041
18.0	1.5	8.62	155.1	0.86153841
18.0	2.0	8.40	151.2	0.84000003
18.0	2.5	8.20	147.5	0.81951225
18.0	3.0	8.00	144.0	0.79999995
18.0	6.0	7.00	126.0	0.69999999
18.0	12.0	5.60	100.8	0.56000006
18.0	24.0	4.00	72.0	0.39999998
21.0	0.5	7.81	164.1	0.91162783
21.0	1.0	7.64	160.4	0.89090902
21.0	1.5	7.47	156.9	0.87111104
21.0	2.0	7.30	153.4	0.85217386
21.0	2.5	7.15	150.1	0.83484261
21.0	3.0	7.00	147.0	0.81677778

21.0	24.0	3.73	78.4	0.437	364
24.0	0.5	6.86	164.6	0.914	566
24.0	1.0	6.72	161.3	0.89599997	
24.0	1.5	6.59	158.1	0.87843132	
24.0	2.0	6.46	155.1	0.8615384	
24.0	2.5	6.34	152.2	0.84528297	
24.0	3.0	6.22	149.3	0.82962966	
24.0	6.0	5.60	134.4	0.74666667	
24.0	12.0	4.67	112.0	0.62222230	
24.0	24.0	3.50	84.0	0.46666664	
36.0	0.5	4.60	165.7	0.92054790	
36.0	1.0	4.54	163.5	0.90810806	
36.0	1.5	4.48	161.3	0.89599997	
36.0	2.0	4.42	159.2	0.88421041	
36.0	2.5	4.36	157.1	0.87272716	
36.0	3.0	4.31	155.1	0.86153841	
36.0	6.0	4.00	144.0	0.79999995	
36.0	12.0	3.50	126.0	0.69999999	
36.0	24.0	2.80	100.8	0.56000006	
48.0	0.5	3.46	166.3	0.92371130	
48.0	1.0	3.43	164.6	0.91428566	
48.0	1.5	3.39	162.9	0.90505046	
48.0	2.0	3.36	161.3	0.89599997	
48.0	2.5	3.33	159.7	0.88712865	
48.0	3.0	3.29	158.1	0.87843132	
48.0	6.0	3.11	149.3	0.82962966	
48.0	12.0	2.90	134.4	0.74666667	
48.0	24.0	2.33	112.0	0.62222230	
0.8000000	0.7000000	0.6222223	0.5600001	0.5090911	0.4666666
0.3111115	0.1866667	0.1017038	0.8615384	0.8000000	0.7466667
0.7000000	0.6588237	0.6222224	0.4666666	0.3111112	0.1866667
0.8842105	0.8400000	0.8000000	0.7636364	0.7304348	0.7000000
0.5600000	0.4000000	0.2545455	0.8960000	0.8615384	0.9296297
0.9000000	0.7724139	0.7466667	0.6222223	0.4666666	0.3111112
0.9032258	0.8750000	0.8484848	0.9235294	0.8000001	0.7777779
0.6666666	0.5185186	0.3589745	0.9081081	0.8842104	0.8615384
0.8400000	0.8195122	0.8900000	0.7000000	0.5600001	0.4000000
0.9116278	0.8999999	0.8711110	0.9521739	0.8340426	0.8166667
0.7259259	0.5939394	0.4355556	0.9142857	0.8960000	0.8784313
0.8615184	0.8452830	0.8296297	0.7466667		

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LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS		0.800000	0.700000	0.622222	0.560000	0.509091
NO.	ITEM NAME	AVAILABILITY APPORTIONMENTS				
1	EXPERIMENT	0.989804	0.983753	0.978446	0.973723	0.969470
2	STABIL & CONTROL	0.976802	0.963178	0.951319	0.940834	0.931449
3	THERMAL	0.972935	0.957090	0.943328	0.931186	0.920337
4	STRUCTURE	0.982957	0.972897	0.964109	0.956315	0.949319
5	ELECTRICAL POWER	0.974222	0.959115	0.945984	0.934391	0.924026
6	DATA HAND & COMM.	0.961424	0.939056	0.919758	0.902831	0.887788
7	PRIMARY OPTICS	0.988211	0.978051	0.970910	0.964565	0.958862
8	DOCKING MECH.	0.973900	0.958608	0.945320	0.933589	0.923102
9	PNEUMATICS	0.961742	0.939552	0.920404	0.903607	0.888676

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LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS		0.466667	0.311111	0.186667	0.103704	0.861538
NO.	ITEM NAME	AVAILABILITY APPORTIONMENTS				

1	EXPERIMENT	0.965603	0.947789	0.925813	0.901155	0.993179
2	STABIL. & CONTROL	0.922963	0.884428	0.838160	0.787909	0.984446
3	THERMAL	0.910542	0.866258	0.813520	0.756797	0.981841
4	STRUCTURE	0.942977	0.913978	0.878709	0.839808	0.988584
5	ELECTRICAL POWER	0.914664	0.872273	0.821652	0.767029	0.982709
6	DATA HAND. & COMM.	0.874273	0.813960	0.743861	0.670638	0.974068
7	PRIMARY OPTICS	0.953685	0.929925	0.900833	0.868482	0.990770
8	DOCKING MECH.	0.913632	0.870765	0.819611	0.764458	0.982492
9	PNEUMATICS	0.875261	0.815369	0.745713	0.672894	0.974283

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LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS		0.800000	0.746667	0.700000	0.658824	0.622222
NO.	ITEM NAME	AVAILABILITY APPORTIONMENTS				
1	EXPERIMENT	0.989804	0.986673	0.983753	0.981018	0.978446
2	STABIL. & CONTROL	0.976802	0.969739	0.963178	0.957056	0.951319
3	THERMAL	0.972935	0.964716	0.957090	0.949982	0.943328
4	STRUCTURE	0.982957	0.977746	0.972897	0.968364	0.964109
5	ELECTRICAL POWER	0.974222	0.966387	0.959115	0.952334	0.945984
6	DATA HAND. & COMM.	0.961424	0.949801	0.939056	0.929073	0.919758
7	PRIMARY OPTICS	0.986211	0.981987	0.978051	0.974369	0.970910
8	DOCKING MECH.	0.973900	0.965969	0.958608	0.951745	0.945320
9	PNEUMATICS	0.961742	0.950212	0.939552	0.929647	0.920404

LARGE SPACE TELESCOPE (LST)

MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS

NO.	ITEM	NAME
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EXPERIMENT

2. STABILIZING CONTROL

3 THERMAL

4 STRUCTURE

5TH ELECTRICAL POWER

6 DATA HAND. & COMM.

7. PRIMARY OPTICS

8 DOCKING MECH.

9 PNEUMATICS

LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS	0.800000	0.763636	0.730435	0.700000	0.560000
NO.	ITEM NAME	AVAILABILITY	APPORTIONMENTS		

1	EXPERIMENT	0.989804	0.987692	0.985678	0.983753	0.973723
2	STABIL. & CONTROL	0.976802	0.972034	0.967500	0.963178	0.940834
3	THERMAL	0.972935	0.967385	0.962112	0.957090	0.931186
4	STRUCTURE	0.982957	0.979440	0.976092	0.972897	0.956315
5	ELECTRICAL POWER	0.974222	0.968932	0.963904	0.959115	0.934391
6	DATA HAND. & COMM.	0.961424	0.953572	0.946128	0.939056	0.902831
7	PRIMARY OPTICS	0.986211	0.983361	0.980645	0.978051	0.964565
8	DOCKING MECH.	0.973900	0.968545	0.963456	0.958608	0.933589
9	PNEUMATICS	0.961742	0.953953	0.946568	0.939552	0.903607

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LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS		0.400000	0.254545	0.896000	0.861538	0.829630
NO.	ITEM NAME	AVAILABILITY		APPORTIONMENTS		
1	EXPERIMENT	0.958792	0.939094	0.994969	0.993179	0.991459
2	STABIL. & CONTROL	0.908119	0.865955	0.988516	0.984446	0.980546
3	THERMAL	0.893446	0.845145	0.986588	0.981841	0.977295
4	STRUCTURE	0.931845	0.899957	0.991576	0.988584	0.985714
5	ELECTRICAL POWER	0.898310	0.852025	0.987230	0.982709	0.978378
6	DATA HAND. & COMM.	0.850834	0.785667	0.980826	0.974068	0.967608
7	PRIMARY OPTICS	0.944581	0.918386	0.993190	0.990770	0.988446
8	DOCKING MECH.	0.897092	0.850300	0.987069	0.982492	0.978107
9	PNEUMATICS	0.851989	0.787261	0.980986	0.974283	0.967876

LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS					
NO.	ITEM NAME	AVAILABILITY	APPORTIONMENTS		
1	EXPERIMENT	0.989804	0.988210	0.986673	0.978446
2	STABIL. & CONTROL	0.976802	0.973203	0.969739	0.951319
3	THERMAL	0.972935	0.968746	0.964716	0.943328
4	STRUCTURE	0.932957	0.980303	0.977746	0.964109
5	ELECTRICAL POWER	0.974222	0.970229	0.966387	0.945984
6	DATA HAND. & COMM.	0.961424	0.955495	0.949801	0.919758
7	PRIMARY OPTICS	0.986211	0.984060	0.981987	0.970910
8	DOCKING MECH.	0.973900	0.969858	0.965969	0.945320
9	PNEUMATICS	0.961742	0.955861	0.950212	0.920404

LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS		0.311111	0.903226	0.875000	0.848485	0.823529
NO.	ITEM NAME	AVAILABILITY		APPORTIONMENTS		
1	EXPERIMENT	0.947789	0.995336	0.993886	0.992483	0.991123
2	STABIL. & CONTROL	0.884428	0.989351	0.986053	0.982866	0.979785
3	THERMAL	0.866258	0.997562	0.983715	0.980000	0.976409
4	STRUCTURE	0.913978	0.992190	0.989766	0.987422	0.985154
5	ELECTRICAL POWER	0.872273	0.988158	0.984493	0.980954	0.977533
6	DATA HAND. & COMM.	0.813960	0.982216	0.976734	0.971449	0.966350
7	PRIMARY OPTICS	0.929925	0.993687	0.991726	0.989829	0.987992
8	DOCKING MECH.	0.870765	0.988009	0.984299	0.980715	0.977252
9	PNEUMATICS	0.815369	0.982364	0.976927	0.971686	0.966628

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LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS 0.800000 0.777778 0.666667 0.518519 0.358974

NO. ITEM NAME AVAILABILITY APPORTIONMENTS

1	EXPERIMENT	0.989804	0.989524	0.981551	0.970287	0.954039
2	STABIL. & CONTROL	0.976802	0.973912	0.958248	0.933249	0.897841
3	THERMAL	0.972935	0.969570	0.951365	0.922416	0.881636
4	STRUCTURE	0.982957	0.980826	0.969247	0.950662	0.924110
5	ELECTRICAL POWER	0.974222	0.971015	0.953654	0.926013	0.887005
6	DATA HAND. & COMM.	0.961424	0.956661	0.931013	0.890664	0.834756
7	PRIMARY OPTICS	0.986211	0.984484	0.975087	0.959957	0.938242
8	DOCKING MECH.	0.973900	0.970654	0.953081	0.925112	0.885660
9	PNEUMATICS	0.961742	0.957018	0.931572	0.891531	0.836024

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LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS		0.908108	0.884210	0.861538	0.840000	0.819512
NO.	ITEM NAME	AVAILABILITY APPORTIONMENTS				
1	EXPERIMENT	0.995583	0.994364	0.993179	0.992025	0.990900
2	STABIL. & CONTROL	0.989912	0.987139	0.984446	0.981828	0.979281
3	THERMAL	0.988217	0.984982	0.981841	0.978789	0.975822
4	STRUCTURE	0.992602	0.990565	0.988584	0.986658	0.984783
5	ELECTRICAL POWER	0.988782	0.985701	0.982709	0.979801	0.976974
6	DATA HAND. & COMM.	0.983150	0.978539	0.974068	0.969730	0.965518
7	PRIMARY OPTICS	0.994020	0.992372	0.990770	0.989210	0.987691
8	DOCKING MECH.	0.988641	0.985521	0.982492	0.979548	0.976685
9	PNEUMATICS	0.983290	0.978717	0.974283	0.969980	0.965802

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LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS		0.800000	0.700000	0.560000	0.400000	0.911628
NO.	ITEM NAME	AVAILABILITY APPORTIONMENTS				
1	EXPERIMENT	0.989804	0.983751	0.973723	0.958792	0.995760
2	STABIL. & CONTROL	0.976802	0.963178	0.940834	0.908119	0.990315
3	THERMAL	0.972935	0.957090	0.931186	0.893446	0.988688
4	STRUCTURE	0.982957	0.972897	0.956315	0.931845	0.992898
5	ELECTRICAL POWER	0.974222	0.959115	0.934391	0.898310	0.989230
6	DATA HAND. & COMM.	0.961424	0.939056	0.902831	0.850834	0.983821
7	PRIMARY OPTICS	0.986211	0.978051	0.964565	0.944581	0.994260
8	DOCKING MECH.	0.973900	0.958608	0.933589	0.897092	0.989094
9	PNEUMATICS	0.961742	0.939552	0.903607	0.851989	0.983956

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LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

.....						
AVAILABILITY GOALS		0.890909	0.871111	0.852174	0.834043	0.816667
.....						
NO.	ITEM NAME	AVAILABILITY		APPORTIONMENTS		
.....						
1	EXPERIMENT	0.994709	0.993683	0.992680	0.991700	0.990742
2	STABIL. & CONTROL	0.987923	0.985591	0.983315	0.981093	0.978923
3	THERMAL	0.985897	0.983176	0.980522	0.977933	0.975405
4	STRUCTURE	0.991141	0.989426	0.987752	0.986117	0.984519
5	ELECTRICAL POWER	0.986572	0.983980	0.981452	0.978985	0.976576
6	DATA HAND. & COMM.	0.979841	0.975967	0.972193	0.968514	0.964926
7	PRIMARY OPTICS	0.992838	0.991451	0.990096	0.988772	0.987478
8	DOCKING MECH.	0.986403	0.983779	0.981220	0.978722	0.976283
9	PNEUMATICS	0.980009	0.976167	0.972423	0.968774	0.965215
.....						

LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS	0.725926	0.593939	0.435556	0.914286	0.896000
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NO.	ITEM NAME	AVAILABILITY	APPORTIONMENTS
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1	EXPERIMENT	0.985397	0.976358	0.962549	0.995893	0.994969
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2	STABIL. & CONTROL	0.966870	0.946675	0.916290	0.990618	0.988516
---	-------------------	----------	----------	----------	----------	----------

3	THERMAL	0.961380	0.937948	0.902850	0.989042	0.986588
---	---------	----------	----------	----------	----------	----------

4	STRUCTURE	0.975626	0.960660	0.937979	0.993120	0.991576
---	-----------	----------	----------	----------	----------	----------

5	ELECTRICAL POWER	0.963206	0.940848	0.907308	0.989567	0.987230
---	------------------	----------	----------	----------	----------	----------

6	DATA HAND. & COMM.	0.945096	0.912245	0.863704	0.984326	0.980826
---	--------------------	----------	----------	----------	----------	----------

7	PRIMARY OPTICS	0.980267	0.968103	0.949600	0.994440	0.993190
---	----------------	----------	----------	----------	----------	----------

8	DOCKING MECH.	0.962749	0.940122	0.906192	0.989435	0.987069
---	---------------	----------	----------	----------	----------	----------

9	PNEUMATICS	0.945544	0.912950	0.864768	0.984457	0.980986
---	------------	----------	----------	----------	----------	----------

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LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS		0.878431	0.861538	0.845283	0.829630	0.746667
NO.	ITEM NAME	AVAILABILITY APPORTIONMENTS				
1	EXPERIMENT	0.994065	0.993179	0.992310	0.991459	0.986673
2	STABIL. & CONTROL	0.986459	0.984446	0.982475	0.980546	0.969739
3	THERMAL	0.984188	0.981841	0.979544	0.977295	0.964716
4	STRUCTURE	0.990064	0.988584	0.987135	0.985714	0.977746
5	ELECTRICAL POWER	0.984944	0.982709	0.980520	0.978378	0.966387
6	DATA HAND. & COMM.	0.977408	0.974068	0.970802	0.967608	0.949801
7	PRIMARY OPTICS	0.991967	0.990770	0.989596	0.988446	0.981987
8	DOCKING MECH.	0.984755	0.982492	0.980276	0.978107	0.965969
9	PNEUMATICS	0.977596	0.974283	0.971044	0.967876	0.950212

LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS		0.622222	0.466667	0.920548	0.908108	0.896000
NO.	ITEM NAME	AVAILABILITY APPORTIONMENTS				
1	EXPERIMENT	0.978446	0.965603	0.996205	0.995583	0.994969
2	STABIL. & CONTROL	0.951319	0.922963	0.991330	0.989912	0.988516
3	THERMAL	0.943328	0.910542	0.989872	0.988217	0.986588
4	STRUCTURE	0.964109	0.942977	0.993643	0.992602	0.991576
5	ELECTRICAL POWER	0.945984	0.914664	0.990358	0.988782	0.987230
6	DATA HAND. & COMM.	0.919758	0.874273	0.985511	0.983150	0.980826
7	PRIMARY OPTICS	0.970910	0.953685	0.994862	0.994020	0.993190
8	DOCKING MECH.	0.945320	0.913632	0.990236	0.988641	0.987069
9	PNEUMATICS	0.920404	0.875261	0.985632	0.983290	0.980986

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LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS	0.884210	0.872727	0.861538	0.800000	0.700000
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NO.	ITEM NAME	AVAILABILITY	APPORTIONMENTS
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1	EXPERIMENT	0.994364	0.993767	0.993179	0.989804	0.983753
2	STABIL. & CONTROL	0.987139	0.985783	0.984446	0.976802	0.963178
3	THERMAL	0.984982	0.983400	0.981841	0.972935	0.957090
4	STRUCTURE	0.990565	0.989568	0.988584	0.982957	0.972897
5	ELECTRICAL POWER	0.985701	0.984194	0.982709	0.974222	0.959115
6	DATA HAND. & COMM.	0.978539	0.976286	0.974068	0.961424	0.939056
7	PRIMARY OPTICS	0.992372	0.991565	0.990770	0.986211	0.978051
8	DOCKING MECH.	0.985521	0.983995	0.982492	0.973900	0.958608
9	PNEUMATICS	0.978717	0.976483	0.974283	0.961742	0.939552

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LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

AVAILABILITY GOALS	0.560000	0.923711	0.914286	0.905050	0.896000
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NO.	ITEM NAME	AVAILABILITY	APPORTIONMENTS
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1	EXPERIMENT	0.973723	0.996362	0.995893	0.995429	0.994969
2	STABIL. & CONTROL	0.940834	0.991688	0.990618	0.989561	0.988516
3	THERMAL	0.931186	0.990290	0.989042	0.987808	0.986588
4	STRUCTURE	0.956315	0.993905	0.993120	0.992344	0.991576
5	ELECTRICAL POWER	0.934391	0.990755	0.989567	0.988392	0.987230
6	DATA HAND. & COMM.	0.902831	0.986107	0.984326	0.982566	0.980826
7	PRIMARY OPTICS	0.964565	0.995075	0.994440	0.993812	0.993190
8	DOCKING MECH.	0.933589	0.990639	0.989435	0.988246	0.987069
9	PNEUMATICS	0.903607	0.986223	0.984457	0.982711	0.980986

LARGE SPACE TELESCOPE (LST) MISSION SUCCESS APPORTIONMENT

.....
 . AVAILABILITY GOALS . 0.887129 . 0.878431 . 0.829630 . 0.746667 . 0.622222 .

 . NO. . ITEM NAME . AVAILABILITY APPORTIONMENTS .

1	EXPERIMENT	0.994515	0.994065	0.991459	0.986673	0.978446
2	STABIL. & CONTROL	0.987481	0.986459	0.980546	0.969739	0.951319
3	THERMAL	0.985381	0.984188	0.977295	0.964716	0.943328
4	STRUCTURE	0.990816	0.990064	0.985714	0.977746	0.964109
5	ELECTRICAL POWER	0.986081	0.984944	0.978378	0.966387	0.945984
6	DATA HAND. & COMM.	0.979107	0.977408	0.967608	0.949801	0.919758
7	PRIMARY OPTICS	0.992576	0.991967	0.988446	0.981987	0.970910
8	DOCKING MECH.	0.985906	0.984755	0.978107	0.965969	0.945320
9	PNEUMATICS	0.979281	0.977596	0.967876	0.950212	0.920404

QAO/LST/SHUTTLE M T B F APPORTIONMENTS

LST MTTF SHUTTLE DELAY UPTIME RATIO SUBSYSTEM MTBF APPORTIONMENTS (IN HOURS)
(MONTHS) (MONTHS) FOR SYSTEM STABIL & CONT ELECT. POWER COMM/DATA HAND PNEUMATICS

3.0	0.5	0.799999952	107364.8	96492.2	64057.9	64600.9
3.0	1.0	0.699999988	76765.4	68991.7	45801.3	46189.3
3.0	1.5	0.622222304	64922.2	58347.8	38735.1	39063.4
3.0	2.0	0.560000062	59027.7	53050.2	35218.2	35516.7
3.0	2.5	0.509091079	55764.0	50117.1	33271.0	33552.9
3.0	3.0	0.466666639	51888.4	48431.3	32151.9	32424.3
3.0	6.0	0.311111450	52762.5	47419.5	31480.1	31746.9
3.0	12.0	0.186666667	61173.8	54979.0	36498.7	36808.0
3.0	24.0	0.103703797	81553.1	73294.5	48657.7	49070.1
6.0	0.5	0.861538410	298539.7	268307.6	178120.0	179629.6
6.0	1.0	0.799999952	214729.6	192984.6	128115.8	129201.7
6.0	1.5	0.746666670	175733.1	157937.4	104849.1	105737.6
6.0	2.0	0.699999988	153530.8	137983.4	91602.5	92378.6
6.0	2.5	0.658823729	139427.7	125308.4	83198.0	83893.0
6.0	3.0	0.622222364	129844.2	116695.5	77470.1	78126.7
6.0	6.0	0.466666639	107776.7	96862.5	64303.7	64848.6
6.0	12.0	0.311111152	105524.8	94838.8	62960.2	63493.8
6.0	24.0	0.186666727	122347.7	109958.1	72997.3	73615.9
9.0	0.5	0.884210527	528427.5	474914.1	315279.8	317951.4
9.0	1.0	0.840000033	392597.3	352841.0	234239.1	236224.2
9.0	1.5	0.799999952	322094.4	289476.9	192173.7	193802.6
9.0	2.0	0.763636410	279221.4	250945.6	166594.1	168006.0
9.0	2.5	0.730434835	250603.3	225225.7	149519.6	150796.6
9.0	3.0	0.699999988	230296.2	206975.1	137403.8	138568.0
9.0	6.0	0.560000002	177083.1	159150.7	106654.7	106550.1
9.0	12.0	0.399999976	156878.7	140992.2	91599.9	94393.1
9.0	24.0	0.254545450	165089.1	148171.2	98498.5	99333.2
12.0	0.5	0.895999969	779160.3	700257.6	464877.3	468816.6
12.0	1.0	0.861538410	597079.4	536615.2	356240.1	359259.2
12.0	1.5	0.829629660	494756.4	444654.6	295190.4	297692.2
12.0	2.0	0.799999952	429459.2	385969.2	256231.6	259403.4
12.0	2.5	0.772413790	384353.9	345431.5	229320.4	231263.8
12.0	3.0	0.746666670	351466.1	315874.9	209693.2	211475.2
12.0	6.0	0.622222304	259648.6	213391.0	154940.3	156253.4
12.0	12.0	0.466666639	215553.4	191725.0	124607.4	129697.2
12.0	24.0	0.311111152	211049.7	189677.6	125920.4	126987.6
15.0	0.5	0.903225780	1042405.0	936845.2	621938.1	627208.4
15.0	1.0	0.875000000	820192.6	737131.6	489357.6	493504.7
15.0	1.5	0.848484755	687410.1	617799.6	410135.1	413611.1
15.0	2.0	0.823529422	599343.6	538651.1	357591.6	360622.7
15.0	2.5	0.800000072	536824.1	482481.5	320249.6	323004.2
15.0	3.0	0.777777851	490268.1	440620.3	292512.7	294991.6
15.0	6.0	0.666666627	354522.6	318621.4	211522.1	213314.3
15.0	12.0	0.518518567	281399.2	252702.4	167893.5	169316.4
15.0	24.0	0.358974457	260572.8	234185.7	154457.8	156785.4
18.0	0.5	0.908108056	1313738.0	1180704.0	781328.6	790472.0
18.0	1.0	0.884210408	1056850.0	949829.1	630558.0	635902.9
18.0	1.5	0.861538410	895619.2	804922.9	534360.1	538889.8
18.0	2.0	0.840000033	785194.7	705782.0	468478.2	472448.4
18.0	2.5	0.819512248	704982.1	634593.1	420620.2	424184.6
18.0	6.0	0.699999988	51888.4	48431.3	32151.9	32424.3

18.0	3.0	0.799999952	544188.9	578955.7	354347.3	371002.1
18.0	6.0	0.699999988	460592.6	413950.3	274807.6	277136.0
18.0	12.0	0.560000062	354166.1	318301.5	211309.4	213100.1
18.0	24.0	0.399999976	313757.4	281984.5	187199.8	188786.1
21.0	0.5	0.911627829	1590619.0	1429536.0	949022.4	957063.2
21.0	1.0	0.890909016	1303676.0	1171657.0	777824.9	784415.6
21.0	1.5	0.8711111035	1116158.0	1003129.4	665943.2	671597.6
21.0	2.0	0.852173865	984197.4	884529.4	587209.6	592186.0
21.0	2.5	0.834042609	886419.2	796656.7	528871.9	533353.7
21.0	3.0	0.816666663	811171.8	729026.2	483976.1	488077.8
21.0	6.0	0.725925922	576998.6	518568.6	344259.9	347177.4
21.0	12.0	0.593939424	433582.9	389676.1	258692.7	260885.1
21.0	24.0	0.435555637	370612.4	333082.4	221121.7	222995.7
24.0	0.5	0.914285660	1871445.0	1681931.0	1116575.0	1126039.0
24.0	1.0	0.895999968	1558320.0	1400515.0	929754.6	937633.2
24.0	1.5	0.878431320	1346647.0	1210281.0	803463.9	810272.6
24.0	2.0	0.861538410	1194158.0	1073230.0	712480.1	718518.4
24.0	2.5	0.845282972	1079190.0	969907.6	643887.6	649344.2
24.0	3.0	0.829629660	989512.9	889309.1	590380.9	595384.6
24.0	6.0	0.746666670	702932.2	631749.8	419396.4	422950.6
24.0	12.0	0.622222304	519377.2	466782.1	309880.6	312506.8
24.0	24.0	0.466666639	431106.8	387450.1	257214.8	259394.6
36.0	0.5	0.920547903	3017953.0	2712347.0	1800626.0	1815886.0
36.0	1.0	0.908108056	2627476.0	2361408.0	1567657.0	1580944.0
36.0	1.5	0.895999968	2337481.0	2100773.0	1394631.0	1406449.0
36.0	2.0	0.884210408	2113700.0	1899656.0	1261116.0	1271805.0
36.0	2.5	0.872727156	1935875.0	1739839.0	1155020.0	1164805.0
36.0	3.0	0.861538410	1791238.0	1609845.0	1068720.0	1077777.0
36.0	6.0	0.799999952	1288377.0	1157907.0	768695.0	775210.2
36.0	12.0	0.699999988	921185.1	827900.7	549615.3	554272.0
36.0	24.0	0.560000062	708332.3	636603.0	422618.8	426200.2
48.0	0.5	0.923711300	4183527.0	3754870.0	2496048.0	2517200.0
48.0	1.0	0.914285660	3742990.0	3363863.0	2233150.0	2252079.0
48.0	1.5	0.905050457	3396316.0	3052177.0	2026366.0	2043543.0
48.0	2.0	0.895999968	3116641.0	2801030.0	1859509.0	1875266.0
48.0	2.5	0.887128651	2886278.0	2594001.0	1722068.0	1736658.0
48.0	3.0	0.878431320	2693294.0	2420563.0	1606927.0	1620545.0
48.0	6.0	0.829629660	1979025.0	1778618.0	1180761.0	1190769.0
48.0	12.0	0.746666670	1405864.0	1263499.0	838792.7	845901.1
48.0	24.0	0.622222304	1038754.4	933564.1	619761.2	625013.6

Appendix Subsection 3B
Multi-state Effectiveness Analytical Technique

ANALYTICAL TECHNIQUE AND SAMPLE PROBLEM:

In order to aid in the understanding of the analytical approach suggested for this study, the following simple example is presented. Consider a system composed of one vehicle with failure rate (λ); repair rate (μ) and repair percentage (π). The states for this system can be given as:

- (1) The vehicle is up.
- (2) The vehicle is down with a failure which can be repaired.
- (3) The vehicle is down with a failure which cannot be repaired.

It can readily be seen that the vehicle cannot be in more than one of these states at any time (mutually exclusive states) and that there are no other possible states (at least for the present scope of the problem) in which the vehicle can be (mutually exhaustive states). *

The problem can now be represented by the state transition diagram given below (Figure 2). +

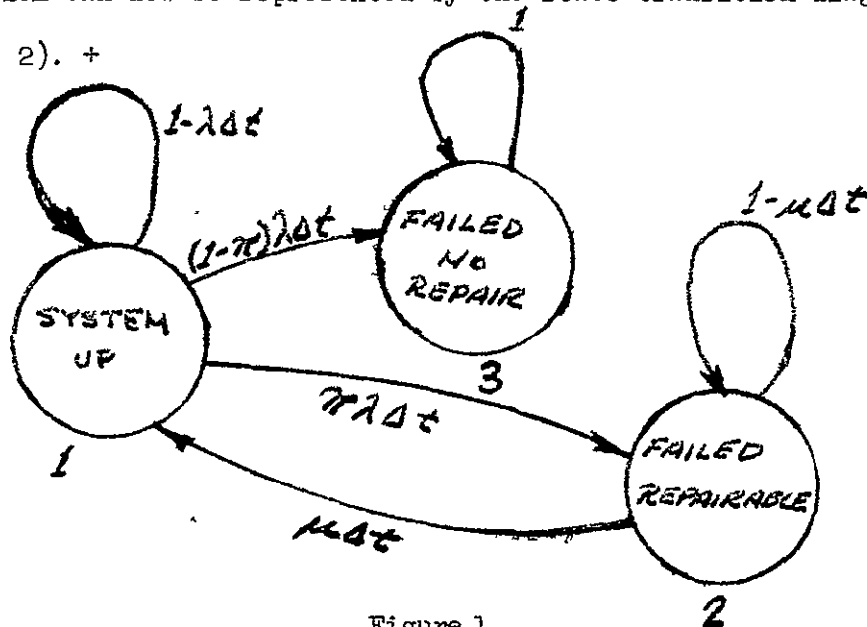


Figure 1

* See Definitions Section for detailed definitions.

+ In order to simplify the state diagrams utilized in this study the "self loops" and Δt factors were eliminated in the figures for Shuttle via Titan Systems.

The directed edges between states in Figure 1 indicate the approximate probability of making a transition from state "i" to state "j" (e.g., $1 \rightarrow 2$) in the small time interval Δt given that we start in state "i" at time "t". Thus the probability of being in a specific state at a time "t + Δt " is equal to the probability of being there at time "t" and remaining until "t + Δt "; plus the probability of being in another state at time "t" making a transition in " Δt " and ending there at "t + Δt ". Specifically if we can write the probability that we are in state 2 at time "t + Δt " as:

$$P_2(t + \Delta t) = \pi \lambda \Delta t P_1(t) + (1 - \mu \Delta t) P_2(t)$$

Rearranging terms we obtain:

$$\frac{P_2(t + \Delta t) - P_2(t)}{\Delta t} = \pi \lambda P_1(t) - \mu P_2(t)$$

Taking the limit on both sides as $\Delta t \rightarrow 0$ (and thus replacing our approximation with the exact answer) we obtain:

$$\frac{dP_2(t)}{dt} = \dot{P}_2(t) = \pi \lambda P_1(t) - \mu P_2(t)$$

In a similar manner we obtain the following set of differential equations:

$$\begin{aligned} \dot{P}_1(t) &= -\lambda P_1(t) + \mu P_2(t) \\ \dot{P}_2(t) &= \pi \lambda P_1(t) - \mu P_2(t) \\ \dot{P}_3(t) &= (1 - \pi) \lambda P_1(t) \end{aligned}$$

The above set of differential equations can be written in matrix form as:

$$\begin{bmatrix} \dot{P}_1(t) \\ \dot{P}_2(t) \\ \dot{P}_3(t) \end{bmatrix} = \begin{bmatrix} -\lambda & \mu & 0 \\ \pi\lambda & -\mu & 0 \\ (1-\pi)\lambda & 0 & 0 \end{bmatrix} \begin{bmatrix} P_1(t) \\ P_2(t) \\ P_3(t) \end{bmatrix}$$

or alternately:

$$[\dot{P}(t)] = [A] [P(t)]$$

where $(P(t))$ is the current state vector and (A) is just the transpose of the transition matrix (M) . That is:

$$[A] = [M]^T$$

implying that:

$$[M] = \begin{bmatrix} -\lambda & \pi\lambda & (1-\pi)\lambda \\ \mu & -\mu & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

Notice that the matrix (A) is a stochastic matrix, that is the sum of the column elements equals zero. This is true for all matrices involved in problems of this type.

The difficulty now results in solving the matrix equation. One method of solving the problem exactly is to take the Laplace transform of each of the individual equations to yield a set of linear homogenous algebraic equations which are then solved by standard techniques, and then take the inverse transform. This technique is exact, however, the solutions are exceedingly difficult to obtain especially if the number of states is large. (Solving this simple 3 state problem using this technique will show the difficulties involved).

Another technique is to write the matrix equation as a simple differential equation implying solutions of the form:

$$[P(t)] = \text{EXP} \{ t[A] \} [P(0)]$$

where $(P(0))$ is the initial condition vector and $e^{t[A]}$ given by:

$$e^{t[A]} = 1 + t[A] + \frac{t^2[A]^2}{2!} + \dots$$

$$= \sum_{i=0}^{\infty} \frac{\{t[A]\}^i}{i!}$$

Here the answer is approximated by taking a number of terms of the series.

This solution, however, converges slowly for large mission times so a large number of terms must be used - thus it is not considered suitable for our application.

A third method of solution for the problem is given in Reference (b) and involves the use of a matrix of the form:

$$[N] \Delta t = [A]^T - [I]$$

$$\text{or } [A]^T = [I] + [N] \Delta t$$

$$\text{or } [M] = [I] + [N] \Delta t$$

Where Δt is of the order of 1×10^{-3} and then raising the matrix to a very high power ($\approx 10^5$) to bring the time within the range of the mission time. This method converges very rapidly and has been programmed and used successfully for problems with as many as 50 states and mission times approaching twenty years. Because of the above attributes, the method explained in Reference (b) was used in this study.

DEFINITIONS:

(a) Multi-State effectiveness Markov Models -

This is the technique suggested to mathematically model the proposed vehicles and missions. These models break down the vehicles' interaction for each phase of the mission into mutually exclusive and mutually exhaustive states. Transitions from individual states to other states in the model are indicated by the product of the failure rate (λ) and the repair percentage (π) for repairable failures, and by the product $(1-\pi)\lambda$ for non-repairable failures (See Figures 2 & 3). Transitions to individual states from other states are indicated by the repair rate (μ).

(b) System State -

A state of a system is a collection of failure and successful events describing a particular system condition. (See Figures 2 & 3).

(c) Mutually Exclusive States -

A set of system states is mutually exclusive if the intersection of each state in the set with all other states is the null set (i.e. \emptyset = set containing no elements). This condition constrains the model so that the system cannot be in more than one state at any time.

(d) Mutually Exhaustive States -

A set of system states is mutually exhaustive if the union of this set with the set of all possible system states is the set itself. This condition constrains the problem so that the system can be in no state other than the set of states given in the model.

DEFINITIONS - (Continued)

(e) Repair Percentage (π) -

The fraction of all possible failures which can occur on the vehicle which can be repaired is the repair percentage. Thus if it is known that on a particular vehicle 9 out of 10 failures which may occur can be repaired, the repair percentage for that particular vehicle is .90.

(f) Initial Condition Vector ($P(t_0)$) -

The vector containing the initial probability of being in each of the "N" states at the start of the problem (i.e. at $t = t_0$) as its "N" components is called the initial condition vector. The initial condition vector is usually taken to be, $(1, 0, 0, \dots, 0)$ implying that the system started in the all up condition.

(g) Current State Vector ($P(t)$) -

The vector containing the probability of being in each of the "N" states at a current time "t" is called the current state vector.

(h) Transition Matrix (M) -

The matrix containing the transition rate from state "i" to state "j" as its $(i, j)^{th}$ element is called the transition matrix.

Appendix Subsection 3C

Multi-state Effectiveness Computer Output Summary

WITH SHUTTLE

THIS IS CASE NUMBER 2

N	MAXRUN	MAXPHS	MAXSLB	NMCDE
10	4	12	0	4

THE H VALUES FOR EACH PHASE ARE-

0.10000E-01 0.10000E-01 0.10000E-01 0.10000E-01 0.10000E-01 0.10000E-01 0.10000E-01 0.10000E-01
0.10000E-01 0.10000E-01 0.10000E-01 0.10000E-01

THE INITIAL CONDITION VECTOR IS -

STATE 1 = 1.0000

STATE 2 = 0.0

STATE 3 = 0.0

STATE 4 = 0.0

STATE 5 = 0.0

STATE 6 = 0.0

STATE 7 = 0.0

STATE 8 = 0.0

STATE 9 = 0.0

STATE 10 = 0.0

1	0	0	0
1	0	0	0
1	0	0	0
0	1	0	0
0	1	0	0
0	1	0	0
0	0	1	0
0	0	1	0
0	0	1	0
0	0	1	0
0	0	1	0
0	0	0	1

PHASE 1 = 4380.00 HOURS
PHASE 2 = 4380.00 HOURS
PHASE 3 = 4380.00 HOURS
PHASE 4 = 4380.00 HOURS
PHASE 5 = 4380.00 HOURS
PHASE 6 = 4380.00 HOURS
PHASE 7 = 4380.00 HOURS
PHASE 8 = 4380.00 HOURS
PHASE 9 = 4380.00 HOURS
PHASE 10 = 4380.00 HOURS
PHASE 11 = 4380.00 HOURS
PHASE 12 = 4380.00 HOURS

0.0 0.29140E-04 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.1000CE 01

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9613

STATE 2 = 0.0366

STATE 3 = 0.0007

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0014

THIS IS RUN NUMBER 2

WITHOUT SHUTTLE

LAM LAM1 LAM2 LAMS LAMR LAMA PI P11 P12 D MU LAMD

0.50E-05 0.24E-05 0.80E-04 0.31E-04 0.11E-02 0.57E-04 0.75E-00 0.50E-00 0.90E-00 72.00 10.00 0.10E-11

0.0	0.50000E-03	0.0	0.0	0.0	0.10000E-14
0.0	0.0	0.34380E-05	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.22920E-05	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.34380E-05	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.0

AT TIME IN RUN = 0.0

MODE 1 = 1.00

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.0

0.99950E 00	0.42019E-03	0.70524E-04	0.51767E-05	0.46545E-06	0.35206E-05
0.0	0.69911E-00	0.25467E-00	0.28627E-01	0.35468E-02	0.14051E-01
0.0	0.0	0.78400E 00	0.16978E 00	0.32174E-01	0.14051E-01
0.0	0.0	0.0	0.69911E-00	0.28684E-00	0.14051E-01
0.0	0.0	0.0	0.0	0.78595E 00	0.14052E-01
0.0	0.0	0.0	0.0	0.0	0.10000E-01

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9995

STATE 2 = 0.0004

STATE 3 = 0.0001

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

AT TIME = 18000.00 END OF PHASE - 1 TOTAL TIME - 18000.00

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.913930813	1	0.915209174
2	0.001278400	2	0.029327799
3	0.001809807	3	0.0
4	0.001160459	4	0.055461217
5	0.026357535		
6	0.055461217		

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9950

STATE 2 = 0.0042

STATE 3 = 0.0007

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0000

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00

AT TIME = 0.00 CASE TOTAL IN 0.00

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.98019E741	1	0.999227703
2	0.016663317	2	0.000075519
3	0.002365684	3	0.000256003
4	0.000014037	4	0.000440733
5	0.000021944		
6	0.000039538		
7	0.000022544		
8	0.00023459		
9	0.000000000		
10	0.000440733		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4332.01

0.0	0.42500E-07	0.75000E-08	0.0	0.0	0.0	0.0	0.0
0.0	0.10000E-13						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.50000E-07						
0.0	0.0	0.0	0.15000E-06	0.0	0.0	0.45000E-07	0.47568E-06
0.0	0.50954E-06						
0.0	0.0	0.0	0.0	0.22920E-04	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.11460E-04	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.10000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						

AT TIME IN RUN = 4000.00

MODE 1 = 1.00

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.00

0.99501E 00	0.42208E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04
0.69480E-72	0.29146E-04						
0.0	0.99501E 00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.49875E-02						
0.92641E-65	0.13273E-67	0.88868E 00	0.54120E-02	0.57472E-02	0.29000E-02	0.42099E-02	0.44164E-01
0.18110E-68	0.48890E-01						
0.82874E-66	0.11772E-68	0.20199E-69	0.99812E-01	0.42832E 00	0.45949E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.31397E 00	0.67365E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.20754E-72	0.98762E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.96937E 00	0.21252E-68
0.36295E-67	0.30628E-01						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.20180E-69	0.96937E 00
0.36295E-67	0.30628E-01						
0.99501E 00	0.42208E-02	0.70563E-03	0.28374E-05	0.19016E-05	0.63824E-06	0.16117E-05	0.16946E-04

AT TIME = 4000.00 END OF PHASE = 2112.00 TILTAL TIME 8000.00

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.963433385	1	0.998470187
2	0.032711662	2	0.000074227
3	0.002325221	3	0.000251624
4	0.000013797	4	0.001203881
5	0.000021569		
6	0.000038862		
7	0.000022158		
8	0.000029466		
9	0.000000000		
10	0.001203881		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4329.35

0.0	0.42500E-07	0.75000E-08	0.0	0.0	0.0	0.0	0.0
0.0	0.10000E-13						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.50000E-07						
0.0	0.0	0.0	0.15000E-06	0.0	0.0	0.45000E-07	0.47500E-06
0.0	0.50954E-06						
0.0	0.0	0.0	0.0	0.22920E-04	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.11460E-04	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.10000E-00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						

AT TIME IN RUN = 8000.00

MODE 1 = 1.00

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.00

NOT REPRODUCIBLE

0.99501E-00	0.42288E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04
0.69480E-72	0.29146E-04						
0.0	0.99501E-00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.49875E-02						
0.92641E-05	0.13273E-07	0.88868E-00	0.54120E-02	0.57472E-02	0.29000E-02	0.42099E-02	0.44164E-01
0.18110E-08	0.48890E-01						
0.82874E-60	0.11772E-68	0.20195E-69	0.99812E-01	0.42832E-00	0.45949E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20195E-69	0.51148E-72	0.31397E-00	0.67365E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-60	0.11772E-68	0.20195E-69	0.51148E-72	0.20754E-72	0.98762E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.96937E-00	0.21252E-08
0.36295E-67	0.30620E-01						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.20180E-69	0.96937E-00
0.36295E-67	0.30620E-01						
0.99501E-00	0.42284E-02	0.70556E-03	0.28374E-05	0.19016E-05	0.63824E-06	0.16112E-05	0.16946E-04

0.0	0.29140E-04								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0.0	0.10000E 01								

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9613

STATE 2 = 0.0366

STATE 3 = 0.0007

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0014

AT TIME 0.0 END PHASE 3T TIME 0.0

STATE NO.	STATE PROB.	MODE NO.	MODE PROP.
1	0.946954787	1	0.997402251
2	0.048162095	2	0.000072958
3	0.002285450	3	0.000247320
4	0.000013561	4	0.002277396
5	0.000021200		
6	0.000038197		
7	0.000021779		
8	0.000225541		
9	0.000000000		
10	0.002277396		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4325.32

0.0	0.42500E-07	0.75000E-08	0.0	0.0	0.0	0.0	0.0
0.0	0.10000E-13						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.50000E-07						
0.0	0.0	0.0	0.15000E-06	0.0	0.0	0.45000E-07	0.47568E-06
0.0	0.50954E-06						
0.0	0.0	0.0	0.0	0.22920E-04	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.11460E-04	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.10000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						

AT TIME IN RUN = 12000.00

MODE 1 = 1.00

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.00

0.99501E 00	0.42288E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04
0.69480E-72	0.29146E-04						
0.0	0.99501E 00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.49875E-02						
0.92641E-65	0.13273E-67	0.88868E 00	0.54120E-02	0.57472E-02	0.29000E-02	0.42099E-02	0.44164E-01
0.18110E-68	0.48300E-01						
0.82874E-66	0.11772E-68	0.20199E-69	0.99812E-01	0.42032E 00	0.45949E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.31397E 00	0.67365E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.20754E-72	0.98762E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.36769E-63	0.79748E-02	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.96937E 00	0.21252E-68
0.36295E-67	0.30620E-01						
0.36769E-63	0.79748E-02	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.20180E-69	0.96937E 00
0.36295E-67	0.30620E-01						
0.99501E 00	0.42288E-02	0.70563E-03	0.28378E-05	0.19016E-05	0.63824E-06	0.16112E-05	0.16946E-04

NOT REPRODUCIBLE

0.0
0.0

0.0
0.10000E 01

0.0

0.0

0.0

0.0

0.0

0.0

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9448

STATE 2 = 0.0519

STATE 3 = 0.0007

STATE 4 = 0.0000.

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0025

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AT TIME = 4000.00 END OF PHASE - ACTUAL TIME 16000.00

STATE NO.	STATE PROP.	MODE NO.	MODE PROP.
1	0.930757999	1	0.996035516
2	0.063031197	2	0.000071710
3	0.002246360	3	0.000243090
4	0.000013329	4	0.003649566
5	0.000020837		
6	0.000037544		
7	0.000021407		
8	0.000221683		
9	0.000000000		
10	0.003649566		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4319.97

0.0	0.42500E-07	0.75000E-08	0.0	0.0	0.0	0.0	0.0
0.0	0.10000E-13						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.50000E-07						
0.0	0.0	0.0	0.15000E-06	0.0	0.0	0.45000E-07	0.47568E-06
0.0	0.50954E-06						
0.0	0.0	0.0	0.0	0.22920E-04	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.11460E-04	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.10000E-00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						

AT TIME IN RUN = 16000.00

MODE 1 = 1.00

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.00

0.99501E-00	0.42288E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04
0.69480E-72	0.29140E-04						
0.0	0.99501E-00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.49878E-02						
0.92041E-65	0.13273E-67	0.89868E-00	0.54120E-02	0.57472E-02	0.29000E-02	0.42099E-02	0.44164E-01
0.18110E-68	0.48890E-01						
0.82874E-60	0.11772E-69	0.20199E-69	0.99812E-01	0.42832E-00	0.45949E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.31397E-00	0.67365E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82374E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.20754E-72	0.98762E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.96937E-00	0.21252E-68
0.36295E-67	0.30621E-67						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.20180E-69	0.96937E-00
0.36295E-67	0.30621E-67						
0.99501E-00	0.42288E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04

NOT REPRODUCIBLE

0.0	0.29140E-04							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0.0	0.10000E 01							

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9287

STATE 2 = 0.0667

STATE 3 = 0.0007

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0040

31

AT TIME = 4000.00 END OF PHASE - STCTAL TIME 19999.99

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.914838374	1	0.994381368
2	0.077335060	2	0.000070483
3	0.002207938	3	0.000238932
4	0.000013101	4	0.005308997
5	0.000020481		
6	0.000036902		
7	0.000021041		
8	0.000217891		
9	0.000000000		
10	0.005308997		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4313.36

0.0	0.42500E-07	0.75000E-08	0.0	0.0	0.0	0.0	0.0
0.0	0.10000E-13						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.50000E-07						
0.0	0.0	0.0	0.15000E-06	0.0	0.0	0.45000E-07	0.47568E-06
0.0	0.50954E-06						
0.0	0.0	0.0	0.0	0.22920E-04	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.11460E-04	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.10000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						

AT TIME IN RUN = 19999.99

MODE 1 = 0.99

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.01

0.99501E 00	0.42288E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04
0.69480E-72	0.29146E-04						
0.0	0.99501E 00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.49975E-02						
0.92641E-65	0.13273E-67	0.88968E 00	0.54120E-02	0.57472E-02	0.29000E-02	0.42099E-02	0.44164E-01
0.18110E-68	0.48890E-01						
0.82874E-66	0.11772E-68	0.20199E-69	0.99812E-01	0.42832E 00	0.45949E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.31397E 00	0.67365E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.20754E-72	0.98762E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.36769E-63	0.78465E-66	0.13338E-66	0.41378E-69	0.20766E-69	0.52856E-70	0.96937E 00	0.21252E-68
0.36769E-67	0.30628E-01						
0.36769E-63	0.78465E-66	0.13338E-66	0.41273E-69	0.20766E-69	0.52856E-70	0.20180E-69	0.96937E 00
0.36295E-67	0.30628E-01						
0.99501E 00	0.42288E-02	0.70563E-03	0.28374E-05	0.19016E-05	0.63824E-06	0.16112E-05	0.16946E-04

0.0

0.29140E-04

0.0

0.0

0.0

0.0

0.0

0.0

0.0

0.0

0.0

0.10000E 01

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9128

STATE 2 = 0.0808

STATE 3 = 0.0006

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0057

67

AT TIME = 4000.00 END CF PHASE - 6TCTAL TIME - 23999.99

STATE NO. STATE PROB. MODE NO. MODE PROB.

1	0.899191201	1	0.992451012
2	0.091089666	2	0.000009278
3	0.002170174	3	0.000234846
4	0.000012877	4	0.007244628
5	0.000020131		
6	0.000036271		
7	0.000020681		
8	0.000214165		
9	0.000000000		
10	0.007244628		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4305.53

0.0	0.42500E-07	0.75000E-08	0.0	0.0	0.0	0.0
0.0	0.10000E-13					
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.50000E-07					
0.0	0.0	0.0	0.15000E-06	0.0	0.0	0.45000E-07
0.0	0.50954E-06					0.47568E-06
0.0	0.0	0.0	0.0	0.22920E-04	0.0	0.45000E-07
0.0	0.79552E-07					0.0
0.0	0.0	0.0	0.0	0.0	0.11460E-04	0.45000E-07
0.0	0.79552E-07					0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.45000E-07
0.0	0.79552E-07					0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06					0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06					0.0
0.10000E-00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0					
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0					

AT TIME IN RUN - 23999.99

MODE 1 = 0.99

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.01

0.99501E-00	0.42288E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04
0.69480E-72	0.29146E-04						
0.0	0.99501E-00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.49875E-02						
0.2641E-65	0.13273E-67	0.88868E-00	0.94120E-02	0.57472E-02	0.29000E-02	0.42099E-02	0.44164E-01
0.18110E-63	0.48890E-01						
0.42874E-66	0.11772E-68	0.20199E-69	0.99812E-01	0.42832E-00	0.45949E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.31397E-00	0.67365E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.20754E-72	0.98762E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.36769E-63	0.78465E-66	0.13378E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.96937E-00	0.21252E-68
0.36295E-67	0.30628E-01						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.20180E-69	0.96937E-00
0.36295E-67	0.30628E-01						
0.99501E-00	0.42288E-02	0.70556E-03	0.28374E-05	0.19016E-05	0.63824E-06	0.16112E-05	0.16946E-04

0.0 0.29140E-04 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.10000E 01

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.8972

STATE 2 = 0.0944

STATE 3 = 0.0006

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0077

AT TIME = 4000.00 END OF PHASE - TOTAL TIME - 27999.99

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.883811593	1	0.990254998
2	0.104310393	2	0.000068093
3	0.002133056	3	0.000230829
4	0.000012656	4	0.009445701
5	0.000019786		
6	0.000035650		
7	0.000020327		
8	0.000210502		
9	0.000000000		
10	0.009445701		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4296.52

0.0	0.42500E-07	0.75000E-08	0.0	0.0	0.0	0.0	0.0
0.0	0.10000E-13						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.50000E-07						
0.0	0.0	0.0	0.15000E-06	0.0	0.0	0.45000E-07	0.47568E-06
0.0	0.50954E-06						
0.0	0.0	0.0	0.0	0.22920E-04	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.11460E-04	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.10000E-00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						

AT TIME IN RUN = 27999.99

MODE 1 = 0.99

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.01

0.99501E-00	0.42288E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04
0.69480E-72	0.29146E-04						
0.0	0.99501E-00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.49975E-02						
0.92641E-65	0.13273E-67	0.88868E-00	0.54120E-02	0.57472E-02	0.29000E-02	0.42099E-02	0.44164E-01
0.18110E-68	0.48890E-01						
0.82874E-66	0.11772E-68	0.20199E-69	0.99812E-01	0.42832E-00	0.45949E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.31397E-00	0.67365E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.20754E-72	0.98762E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.96937E-00	0.21252E-68
0.36295E-67	0.30628E-01						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.20180E-69	0.96937E-00
0.36295E-67	0.30628E-01						
0.99501E-00	0.42288E-02	0.70563E-03	0.28378E-05	0.19016E-05	0.63824E-06	0.16112E-05	0.16946E-04

0.0	0.29140E-04							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0.0	0.10000E 01							

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.8818

STATE 2 = 0.1075

STATE 3 = 0.0006

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0100

AT TIME = 4000.00 END OF PHASE = 3199.99

STATE NO. STATE PROB. MCDE NO. MCDE PROB.

1	0.868655140	1	0.987804115
2	0.117012441	2	0.000066928
3	0.002096573	3	0.000226881
4	0.000012440	4	0.011901762
5	0.000019448		
6	0.000035041		
7	0.000019980		
8	0.000206901		
9	0.000000000		
10	0.011901762		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4286.39

0.0	0.42500E-07	0.75000E-08	0.0	0.0	0.0	0.0	0.0
0.0	0.10000E-13						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.50000E-07						
0.0	0.0	0.0	0.15000E-06	0.0	0.0	0.45000E-07	0.47568E-06
0.0	0.50954E-06						
0.0	0.0	0.0	0.0	0.22920E-04	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.11460E-04	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-69	0.31107E-06						
0.10000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						

AT TIME IN RUN = 3199.99

MODE 1 = 0.99

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.01

0.99501E 00	0.42284E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04
0.69480E-72	0.29146E-04						
0.0	0.99501E 00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.49875E-02						
0.92641E-65	0.13273E-67	0.88868E 00	0.54120E-02	0.57472E-02	0.29000E-02	0.42099E-02	0.44164E-01
0.18110E-68	0.48890E-01						
0.82874E-66	0.11772E-69	0.20199E-69	0.99812E-01	0.42832E 00	0.45949E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.31397E 00	0.67365E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.20754E-72	0.98762E 00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.36760E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.96937E 00	0.21252E-63
0.36295E-67	0.30628E-01						
0.36760E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.20180E-69	0.96937E 00
0.36295E-67	0.30628E-01						
0.99501E 00	0.42284E-02	0.70563E-03	0.28374E-05	0.19016E-05	0.63824E-06	0.16112E-05	0.16946E-04

0.0 0.29140E-04 0.0 0.0 0.0 0.0 0.0 0.0
0.0 C,0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.10000E 01

WHEN C IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.8667

STATE 2 = 0.1201

STATE 3 = 0.0006

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0125

8

AT TIME = 4000.00 END OF PHASE = 9 TOTAL TIME 35999.99

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.853837252	1	0.985108376
2	0.129210413	2	0.000065784
3	0.002060714	3	0.000223000
4	0.000012227	4	0.014602657
5	0.000019115		
6	0.000034441		
7	0.000019638		
8	0.000203363		
9	0.000000000		
10	0.014602657		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4275.18

0.0	0.42500E-07	0.75000E-08	0.0	0.0	0.0	0.0	0.0
0.0	0.10000E-13						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.50000E-07						
0.0	0.0	0.0	0.15000E-06	0.0	0.0	0.45000E-07	0.47568E-06
0.0	0.50954E-06						
0.0	0.0	0.0	0.0	0.22920E-04	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.11460E-04	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.10000E-00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						

AT TIME IN RUN = 35999.99

MODE 1 = 0.99

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.01

0.99501E-00	0.42288E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04
0.69480E-72	0.29146E-04						
0.0	0.99501E-00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.49875E-02						
0.92641E-65	0.13273E-67	0.88868E-00	0.54120E-02	0.57472E-02	0.29000E-02	0.42099E-02	0.44164E-01
0.18110E-68	0.48890E-01						
0.82874E-66	0.11772E-69	0.20195E-69	0.99812E-01	0.42832E-00	0.45949E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.42974E-66	0.11772E-68	0.20195E-69	0.51148E-72	0.31397E-00	0.67365E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-69	0.20195E-69	0.51148E-72	0.20754E-72	0.98762E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.96937E-00	0.21252E-68
0.36295E-67	0.30628E-01						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.20180E-69	0.96937E-00
0.36295E-67	0.30628E-01						
0.99501E-00	0.42288E-02	0.70563E-03	0.28374E-05	0.19016E-05	0.63824E-06	0.16112E-05	0.16946E-04

NOT REPRODUCIBLE

0.0 0.29140E-04 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.10000E 01

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.8519

STATE 2 = 0.1322

STATE 3 = 0.0006

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0153

52⁺
57

AT TIME = 4000.00 END OF PHASE 10 TOTAL TIME 3999.99

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.839233398	1	0.982177436
2	0.140918612	2	0.000064659
3	0.002025468	3	0.000219186
4	0.000012018	4	0.017538521
5	0.000018788		
6	0.000033852		
7	0.000019302		
8	0.000055884		
9	0.000000000		
10	0.017538521		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4262.93

0.0	0.42500E-07	0.75000E-08	0.0	0.0	0.0	0.0	0.0
0.0	0.10000E-13		0.0	0.0	0.0	0.0	0.0
0.0	0.50000E-07		0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.15000E-06	0.0	0.0	0.45000E-07	0.47568E-06
0.0	0.50954E-06		0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.0	0.0	0.0	0.22920E-04	0.0	0.45000E-07	0.0
0.0	0.79552E-07		0.0	0.0	0.11460E-04	0.45000E-07	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.79552E-07	0.0	0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.79552E-07	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06		0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06		0.0	0.0	0.0	0.0	0.0
0.10000E-00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0		0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0		0.0	0.0	0.0	0.0	0.0

AT TIME IN RUN = 3999.99

MODE 1 = 0.98

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.02

0.99501E-00	0.42288E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04
0.69480E-72	0.29146E-04						
0.0	0.99501E-00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.49875E-02						
0.02641E-65	0.13273E-67	0.98868E-00	0.54120E-02	0.57472E-02	0.29000E-02	0.42099E-02	0.44164E-01
0.18110E-68	0.48890E-01						
0.82874E-60	0.11772E-68	0.20199E-69	0.99812E-01	0.42832E-00	0.45949E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82974E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.31397E-00	0.67365E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.20754E-72	0.98762E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.96937E-00	0.21252E-68
0.36295E-67	0.30628E-01						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.20180E-69	0.96937E-00
0.36295E-67	0.30628E-01						
0.99501E-00	0.42288E-02	0.70563E-03	0.28378E-05	0.19016E-05	0.63824E-06	0.16112E-05	0.16946E-04

0.0	0.29140E-04								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
0.0	0.10000E 01								

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.8373

STATE 2 = 0.1438

STATE 3 = 0.0006

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0183

AI TIME = 4000.00 END OF PHASE - INITIAL TIME 43999.99

STATE NO. STATE PROB. MODE NO. MODE PROB.

1	0.824879289	1	0.979021072
2	0.152150989	2	0.000063553
3	0.001990824	3	0.000215437
4	0.000011812	4	0.020699769
5	0.000018467		
6	0.000033273		
7	0.000018972		
8	0.000196465		
9	0.000000000		
10	0.020699769		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4249.68

0.0	0.42500E-07	0.75000E-08	0.0	0.0	0.0	0.0	0.0
0.0	0.10000E-13						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.50000E-07						
0.0	0.0	0.0	0.15000E-06	0.0	0.0	0.45000E-07	0.47568E-06
0.0	0.50954E-06						
0.0	0.0	0.0	0.0	0.22920E-04	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.11460E-04	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.45000E-07	0.0
0.0	0.79552E-07						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.37441E-68	0.31107E-06						
0.10000E-00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0						

AT TIME IN RUN = 43999.99

MODE 1 = 0.98

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.02

0.99501E-00	0.42288E-02	0.70563E-03	0.28378E-05	0.19020E-05	0.63846E-06	0.16115E-05	0.16949E-04
0.69480E-72	0.29146E-04						
0.0	0.99501E-00	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.49875E-02						
0.92641E-65	0.13273E-67	0.89868E-00	0.54120E-02	0.57472E-02	0.29000E-02	0.42099E-02	0.44164E-01
0.13110E-68	0.48890E-01						
0.82874E-66	0.11772E-68	0.20199E-69	0.99812E-01	0.42832E-00	0.45949E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82974E-66	0.11772E-69	0.20199E-69	0.51148E-72	0.31397E-00	0.67365E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.82874E-66	0.11772E-68	0.20199E-69	0.51148E-72	0.20754E-72	0.98762E-00	0.44031E-02	0.24066E-71
0.16484E-69	0.79748E-02						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.96937E-00	0.21252E-66
0.36295E-67	0.30628E-01						
0.36769E-63	0.78465E-66	0.13338E-66	0.41278E-69	0.20766E-69	0.52856E-70	0.20180E-69	0.96937E-00
0.36295E-67	0.30628E-01						
0.99501E-00	0.42288E-02	0.70563E-03	0.28374E-05	0.19016E-05	0.63824E-06	0.16112E-05	0.16946E-04

WITHOUT SHUTTLE

THIS IS CASE NUMBER 1

N MAXRUN MAXPHS MAXSUB NMODE
6 4 6 0 4

THE H VALUES FOR EACH PHASE ARE-

0.10000E-02 0.10000E-02 0.10000E-02 0.10000E-02 0.10000E-02 0.10000E-02

THE INITIAL CONDITION VECTOR IS

STATE 1 = 1.0000

STATE 2 = 0.0

STATE 3 = 0.0

STATE 4 = 0.0

STATE 5 = 0.0

STATE 6 = 0.0

6/4
1 0 0 0
1 0 0 0
0 1 0 0
0 1 0 0
0 1 0 0
0 0 0 1

PHASE 1 = 17520.00 HOURS

PHASE 2 = 26280.00 HOURS

PHASE 3 = 26280.00 HOURS

PHASE 4 = 26280.00 HOURS

PHASE 5 = 26280.00 HOURS

PHASE 6 = 26280.00 HOURS

0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.8230

STATE 2 = 0.1549

STATE 3 = 0.0006

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

STATE 7 = 0.0000

STATE 8 = 0.0000

STATE 9 = 0.0000

STATE 10 = 0.0215

NOT REPRODUCIBLE

AT TIME = 4000.00 END OF PHASE - 12 TOTAL TIME = 47999.99
 STATE NO. STATE PROB. MODE NO. MODE PROB.
 1 0.810770631 1 0.975648463
 2 0.162921071 2 0.000062466
 3 0.001956774 3 0.000211753
 4 0.000011610 4 0.024077088
 5 0.000018151
 6 0.000032704
 7 0.000018647
 8 0.000193105
 9 0.000000000
 10 0.024077088

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 4235.48

THIS IS RUN NUMBER 2

WITHOUT SHUTTLE

LAM LAM1 LAM2 LAMS LAMR LAMA PI P11 P12 D MU LAMD

0.50F-05 0.24E-05 0.80F-04 0.31E-04 0.11E-02 0.57F-04 0.75F-00 0.50E-00 0.90F-00 72.00 10.00 0.10E-11

0.0 0.50000E-08 0.0 0.0 0.0 0.10000F-14

0.0 0.0 0.34380E-05 0.0 0.0 0.14151E-06

0.0 0.0 0.0 0.22920E-05 0.0 0.14151E-06

0.0 0.0 0.0 0.0 0.34380E-05 0.14151E-06

0.0 0.0 0.0 0.0 0.0 0.14151E-06

0.0 0.0 0.0 0.0 0.0 0.0

AT TIME IN RUN 0.0

MODE 1 1.00

MODE 2 0.0

MODE 3 0.0

MODE 4 0.0

0.99950E 00 0.42019F-03 0.70524F-04 0.51767F-05 0.46545E-06 0.35206F-05

0.0 0.69911E-00 0.25467F-00 0.28627F-01 0.35468F-02 0.14051E-01

0.0 0.0 0.78400F 00 0.16978E 00 0.32174F-01 0.14051F-01

0.0 0.0 0.0 0.69911F 00 0.28684F 00 0.14051E-01

0.0 0.0 0.0 0.0 0.78495F 00 0.14052F-01

0.0 0.0 0.0 0.0 0.0 0.10000E-01

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9995

STATE 2 = 0.0004

STATE 3 = 0.0001

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

AT TIME = 18000.00 END OF PHASE - TOTAL TIME = 18000.00

STATE NO. STATE PROJ. MODE NO. MODE PROJ.

1 0.913930433 1 0.915209174

2 0.001278490 2 0.029327799

3 0.001909807 3 0.0

4 0.001160459 4 0.055461217

5 0.026357535

6 0.055461217

---THE EXPECTED TIME IN MODE 1 FOR THIS PHASE---17267.82

0.0	0.50000E-08	0.0	0.0	0.0	0.10000E-14
0.0	0.0	0.34380E-05	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.22920E-05	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.34380E-05	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.0

---AT TIME IN RUN---18090.00

---MODE 1---1.00

---MODE 2---0.0

---MODE 3---0.0

---MODE 4---0.0

0.99950E 00	0.42019E-03	0.70524E-04	0.51767E-05	0.46545E-06	0.35206E-05
0.0	0.69911E-00	0.25467E-00	0.28627E-01	0.35468E-02	0.14051E-01
0.0	0.0	0.78400E 00	0.16978E 00	0.32174E-01	0.14051E-01
0.0	0.0	0.0	0.69911E-00	0.28684E-00	0.14051E-01
0.0	0.0	0.0	0.0	0.98595E 00	0.14052E-01
0.0	0.0	0.0	0.0	0.0	0.10000E-01

---WHEN G IS 1, THE STATE VECTOR IS 0

---STATE 1 = 0.9995

---STATE 2 = 0.0004

---STATE 3 = 0.0001

---STATE 4 = 0.0000

---STATE 5 = 0.0000

---STATE 6 = 0.0000

AT TIME = 26699.99 END OF PHASE 2 TOTAL TIME 44699.99

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.875027001	1	0.876250982
2	0.001223981	2	0.029987842
3	0.001732768	3	0.0
4	0.001111061	4	0.093756557
5	0.027144015		
6	0.093756557		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 25087.29

0.0	0.50000E-09	0.0	0.0	0.0	0.10000E-14
0.0	0.0	0.34380E-05	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.22920E-05	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.34380E-05	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.0

AT TIME IN RUN = 44699.99

MODE 1 = 1.00

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.0

0.49950E-00	0.42019E-03	0.70524E-04	0.51767E-05	0.46545E-06	0.35206E-05
0.0	0.69911E-00	0.25467E-00	0.28627E-01	0.35468E-02	0.14051E-01
0.0	0.0	0.79400E-00	0.16978E-00	0.32174E-01	0.14051E-01
0.0	0.0	0.0	0.69911E-00	0.28684E-00	0.14051E-01
0.0	0.0	0.0	0.0	0.98595E-00	0.14052E-01
0.0	0.0	0.0	0.0	0.0	0.10000E-01

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9995

STATE 2 = 0.0004

STATE 3 = 0.0001

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

NOT REPRODUCIBLE

AT TIME = 26699.99 END OF PHASE - 3 TOTAL TIME = 71399.94

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.875027001	1	0.876250982
2	0.001223981	2	0.029987842
3	0.001732768	3	0.0
4	0.001111001	4	0.093756557
5	0.027144015		
6	0.093756557		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 25087.29

0.0	0.50000E-08	0.0	0.0	0.0	0.10000E-14
0.0	0.0	0.34380E-05	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.22920E-05	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.34380E-05	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.0

AT TIME IN RUN 71399.94

MODE 1 = 1.00

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.0

0.99950E 00	0.42019E-03	0.70524E-04	0.51767E-05	0.46545E-06	0.35206E-05
0.0	0.69911E-00	0.25467E-00	0.28627E-01	0.35468E-02	0.14051E-01
0.0	0.0	0.78400E 00	0.16978E 00	0.32174E-01	0.14051E-01
0.0	0.0	0.0	0.69911E-00	0.28684E-00	0.14051E-01
0.0	0.0	0.0	0.0	0.98595E 00	0.14052E-01
0.0	0.0	0.0	0.0	0.0	0.10000E-01

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9995

STATE 2 = 0.0004

STATE 3 = 0.0001

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

AT TIME = 26699.99 END OF PHASE 4 TOTAL TIME = 98099.94

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.875027001	1	0.876250982
2	0.001223981	2	0.029987842
3	0.001732768	3	0.0
4	0.001111061	4	0.093756557
5	0.027144015		
6	0.093756557		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 25087.29

0.0	0.50000E-08	0.0	0.0	0.0	0.10000E-14
0.0	0.0	0.34380E-05	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.22920E-05	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.34380E-05	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.0

AT TIME IN RUN = 98099.94

MODE 1 = 1.00

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.0

0.99950E-00	0.42019E-03	0.70524E-04	0.51767E-05	0.46545E-06	0.35206E-05
0.0	0.69911E 00	0.25467E 00	0.28627E-01	0.35468E-02	0.14051E-01
0.0	0.0	0.78400E-00	0.16978E-00	0.32174E-01	0.14051E-01
0.0	0.0	0.0	0.69911E 00	0.28684E 00	0.14051E-01
0.0	0.0	0.0	0.0	0.98595E-00	0.14052E-01
0.0	0.0	0.0	0.0	0.0	0.10000E 01

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9995

STATE 2 = 0.0004

STATE 3 = 0.0001

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

AT TIME = 26699.99 END OF PHASE - TOTAL TIME - 124799.94

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.875027001	1	0.876250982
2	0.001223981	2	0.029987842
3	0.001732768	3	0.0
4	0.001111061	4	0.093756557
5	0.027144015		
6	0.093756557		

THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 25087.24

0.0	0.50000E-08	0.0	0.0	0.0	0.10000E-14
0.0	0.0	0.34380E-05	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.22920E-05	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.34380E-05	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.14151E-06
0.0	0.0	0.0	0.0	0.0	0.0

AT TIME IN RUN 124799.94

MODE 1 = 1.00

MODE 2 = 0.0

MODE 3 = 0.0

MODE 4 = 0.0

0.99950E 00	0.42019E-03	0.70524E-04	0.51767E-05	0.46545E-06	0.35206E-05
0.0	0.69911E-00	0.25467E-00	0.28627E-01	0.35468E-02	0.14051E-01
0.0	0.0	0.74400E 00	0.16978E 00	0.32174E-01	0.14051E-01
0.0	0.0	0.0	0.69911E-00	0.28684E-00	0.14051E-01
0.0	0.0	0.0	0.0	0.98595E 00	0.14052E-01
0.0	0.0	0.0	0.0	0.0	0.10000E-01

NOT REPRODUCIBLE

WHEN G IS 1, THE STATE VECTOR IS 0

STATE 1 = 0.9995

STATE 2 = 0.0004

STATE 3 = 0.0001

STATE 4 = 0.0000

STATE 5 = 0.0000

STATE 6 = 0.0000

AT TIME = 26699.99 END OF PHASE - TOTAL TIME - 151499.94

STATE NO.	STATE PROB.	MODE NO.	MODE PROB.
1	0.875027001	1	0.876250982
2	0.001223981	2	0.029987842
3	0.001732768	3	0.0
4	0.001111061	4	0.093756557
5	0.027144015		
6	0.093756557		

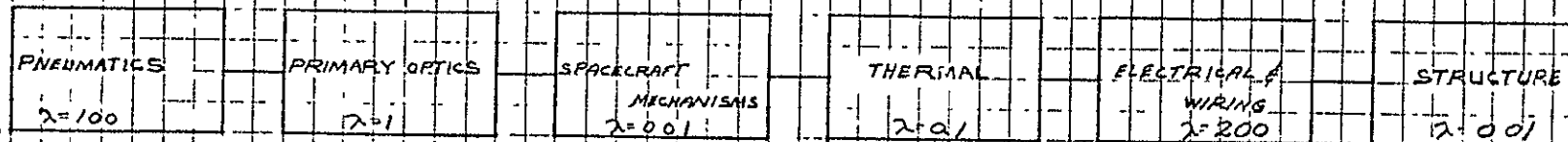
THE EXPECTED TIME IN MODE 1 FOR THIS PHASE = 25087.29

Appendix Subsection 3D
Subsystem and Group Reliability Block Diagrams

GROUP LEVEL FAILURE RATE ANALYSIS

GROUP I

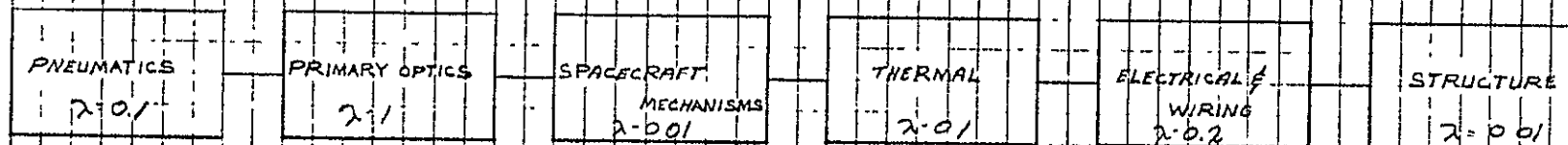
• AIRCRAFT



* $\lambda_{\text{AIRCRAFT}} = 301.12$

MTBF AIRCRAFT = 3,320 HRS.

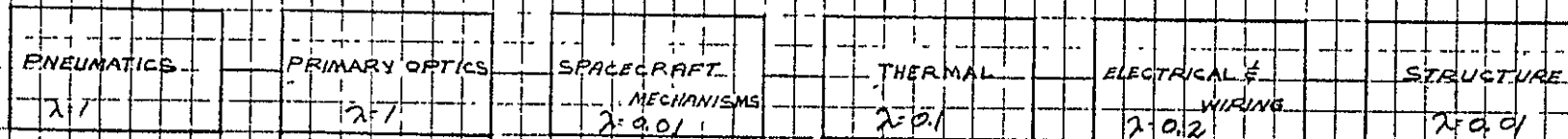
• OAO



$\lambda_{\text{OAO}} = 1.42$

MTBF OAO = 704,225 HRS.

• LM



$\lambda_{\text{LM}} = 2.32$

MTBF LM = 431,034 HRS.

ALL λ ARE IN FAILURES PER 10^6 HRS.

NOT REPRODUCIBLE

GROUP LEVEL FAILURE RATE ANALYSIS

GROUP 2:

AIRCRAFT

STABILIZATION
& CONTROL
 $\lambda = 3914$

PNEUMATICS
 $\lambda = 1946$

THERMAL
 $\lambda = 1$

COMMUNICATION
& DATA HANDLING
 $\lambda = 14950$

POWER
SUBSYSTEMS
 $\lambda = 29822$

ON-AXIS
EXPERIMENT
 $\lambda = 57$

S&C OFFSET
TRACKER
 $\lambda = 0.64$

$\lambda_{\text{AIRCRAFT}} = 50,690.64$

MTBF AIRCRAFT = 19 HRS

OAO

STABILIZATION
& CONTROL
 $\lambda = 27,998$

PNEUMATICS
 $\lambda = 0.933$

THERMAL
 $\lambda = 1$

COMMUNICATION
& DATA HANDLING
 $\lambda = 7,725$

POWER
SUBSYSTEMS
 $\lambda = 4,507$

ON-AXIS
EXPERIMENT
 $\lambda = 57.1$

S&C OFFSET
TRACKER
 $\lambda = 0.64$

$\lambda_{\text{OAO}} = 99.327$

MTBF OAO = 10,067 HRS

LM

STABILIZATION
& CONTROL
 $\lambda = 25,314$

PNEUMATICS
 $\lambda = 17,233$

THERMAL
 $\lambda = 1$

COMMUNICATION
& DATA HANDLING
 $\lambda = 30,840$

POWER
SUBSYSTEMS
 $\lambda = 4,325$

ON-AXIS
EXPERIMENT
 $\lambda = 57.1$

S&C OFFSET
TRACKER
 $\lambda = 0.64$

$\lambda_{\text{LM}} = 136,452$

MTBF LM = 7,328

NOTE: ALL λ ARE IN FAILURES PER 10^6 HRS

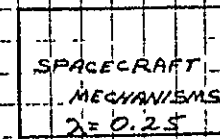
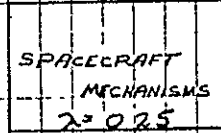
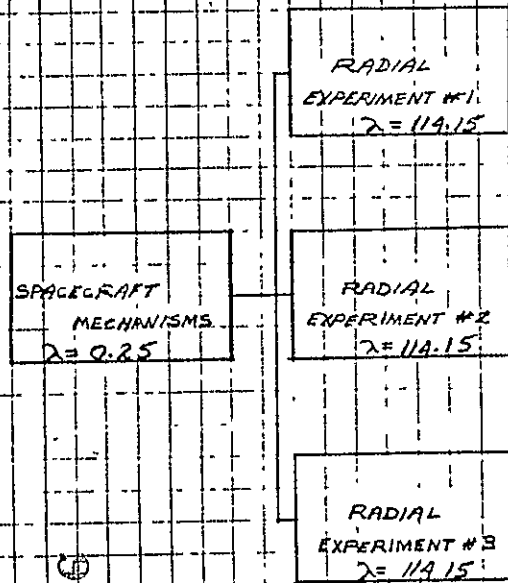
GROUP LEVEL FAILURE RATE ANALYSIS

GROUP 3:

AIRCRAFT

OAO

LM



$$\lambda_{AIRCRAFT} = 37.56$$

$$MTBF_{AIRCRAFT} = 26,624 \text{ HRS}$$

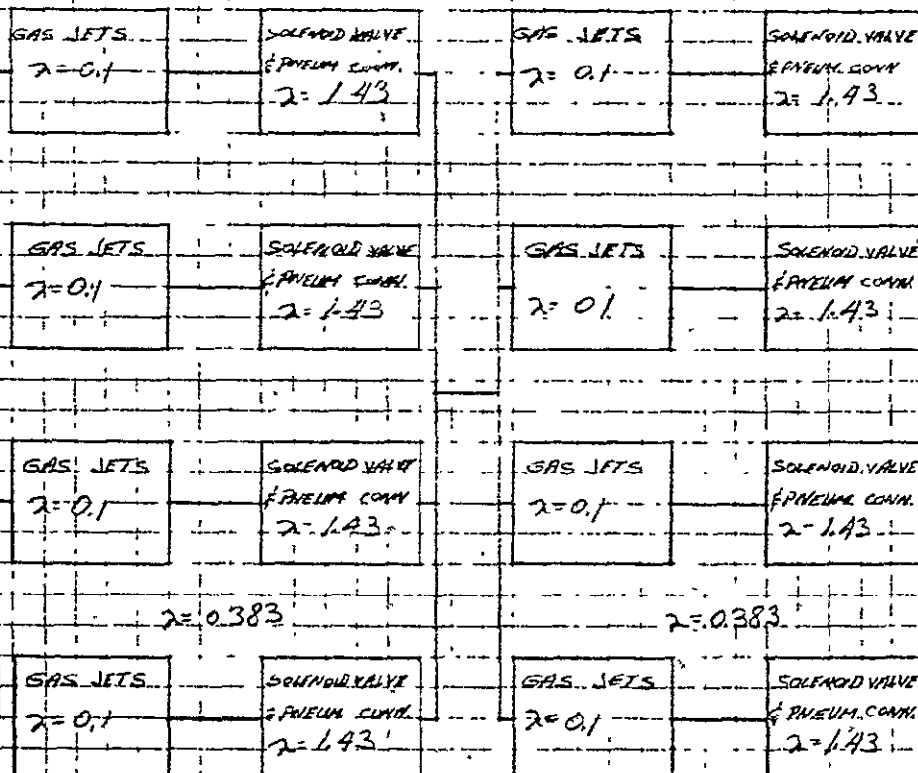
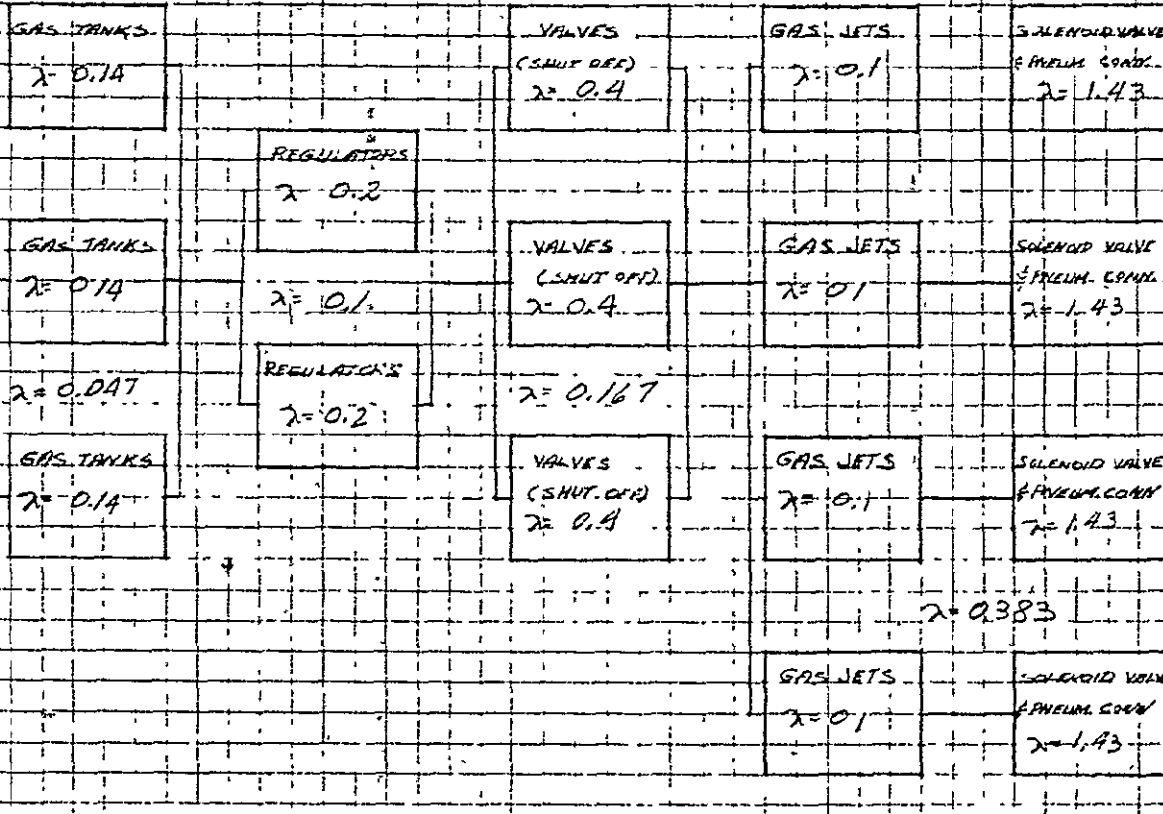
$$\lambda_{OAO} = 37.56$$

$$MTBF_{OAO} = 26,624 \text{ HRS}$$

$$\lambda_{LM} = 37.56$$

$$MTBF_{LM} = 26,624 \text{ HRS}$$

*NOTE: ALL λ ARE IN FAILURES PER 10^6 HRS

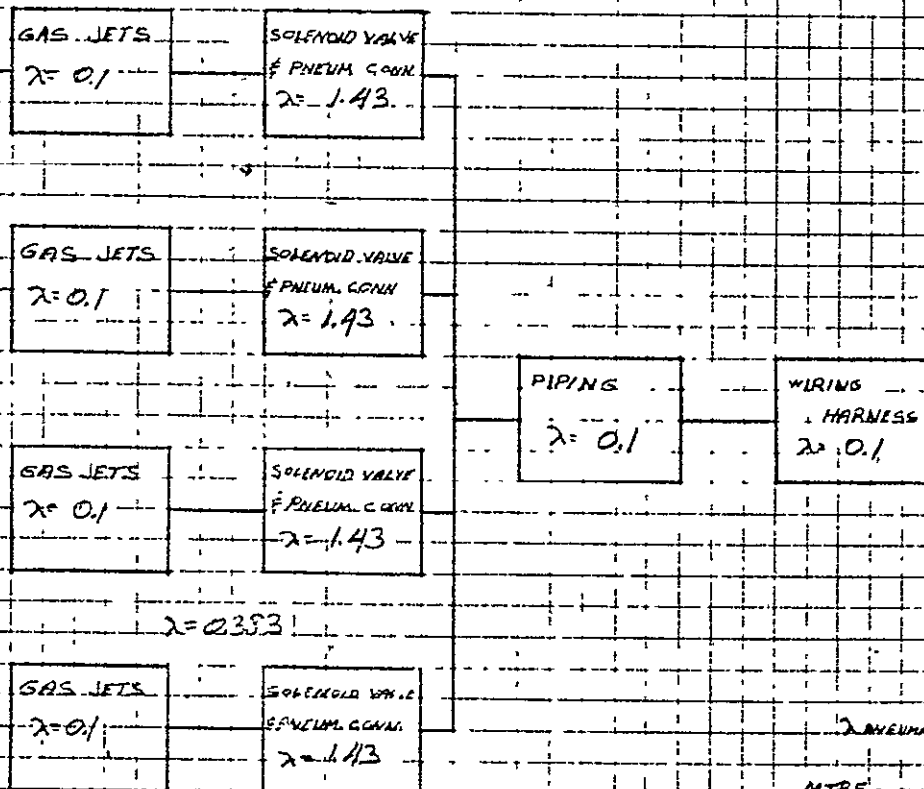


OVER

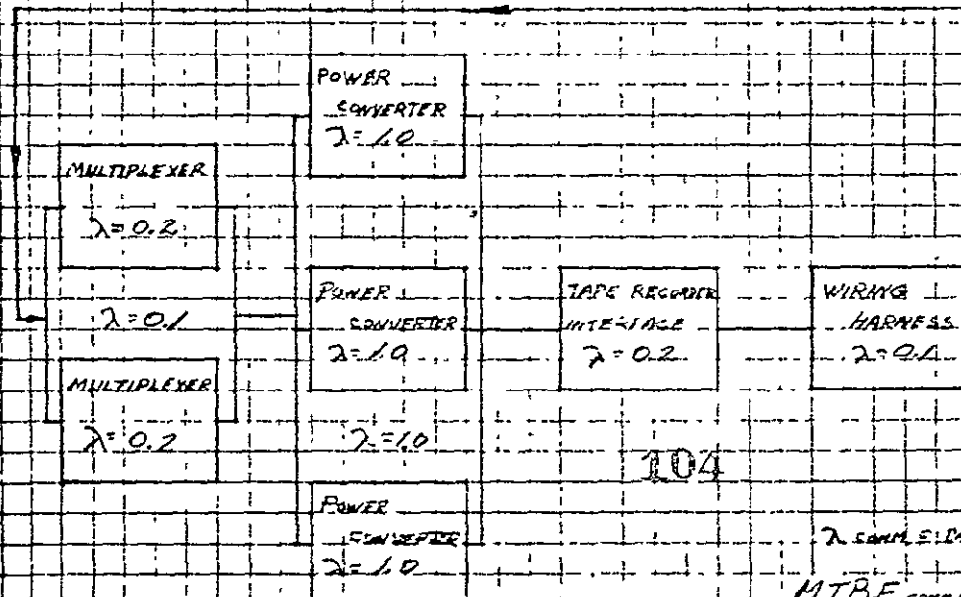
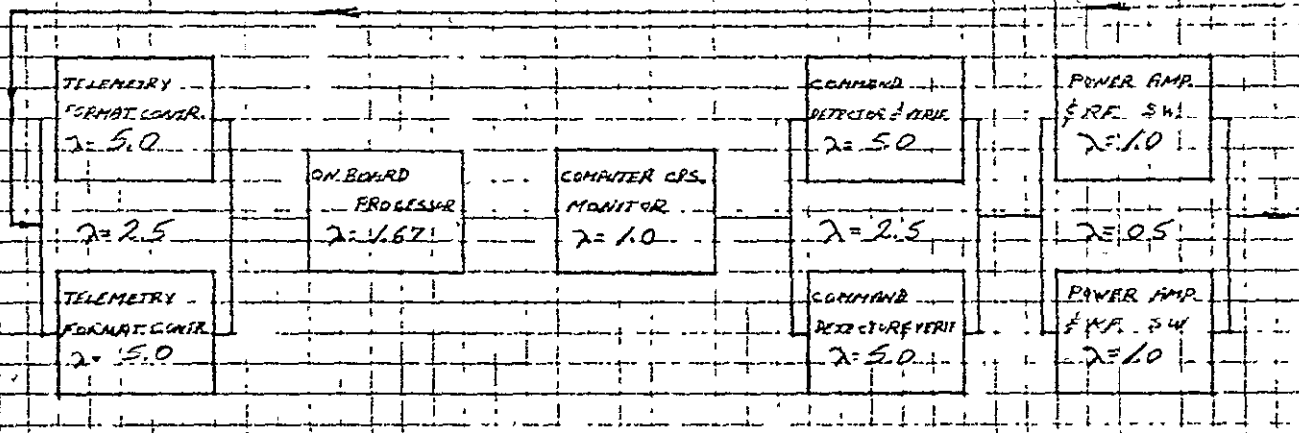
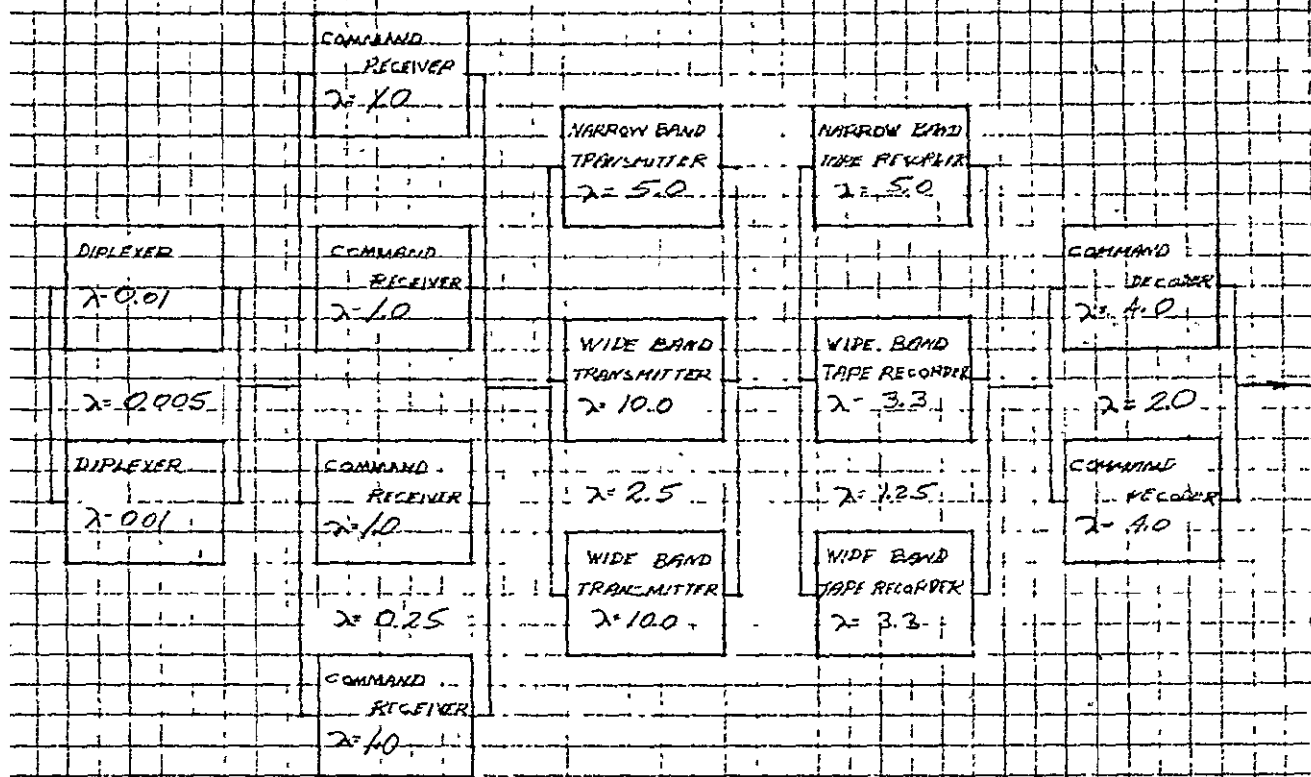
ALL λ ARE IN FAILURES PER 10³ HRS

PNEUMATICS (CONTINUED)

EQUIPMENT LEVEL AIRCRAFT

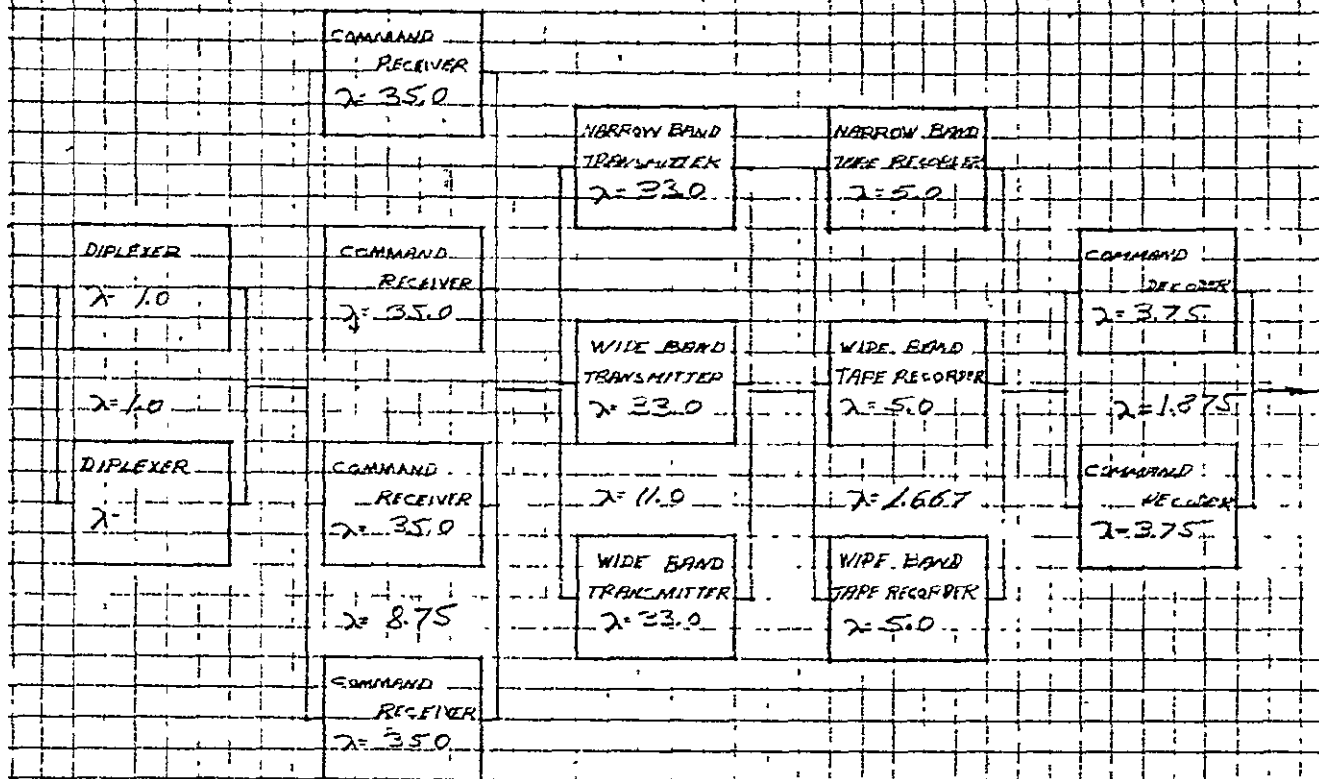


EQUIPMENT LEVEL AIRCRAFT.

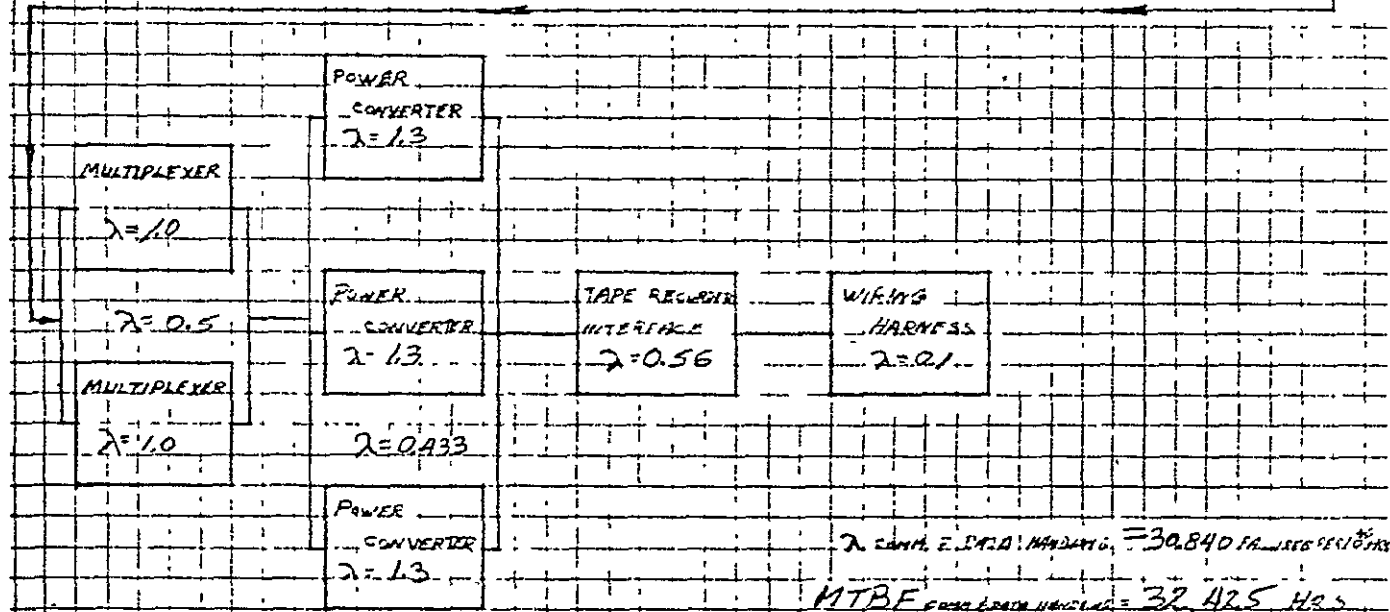
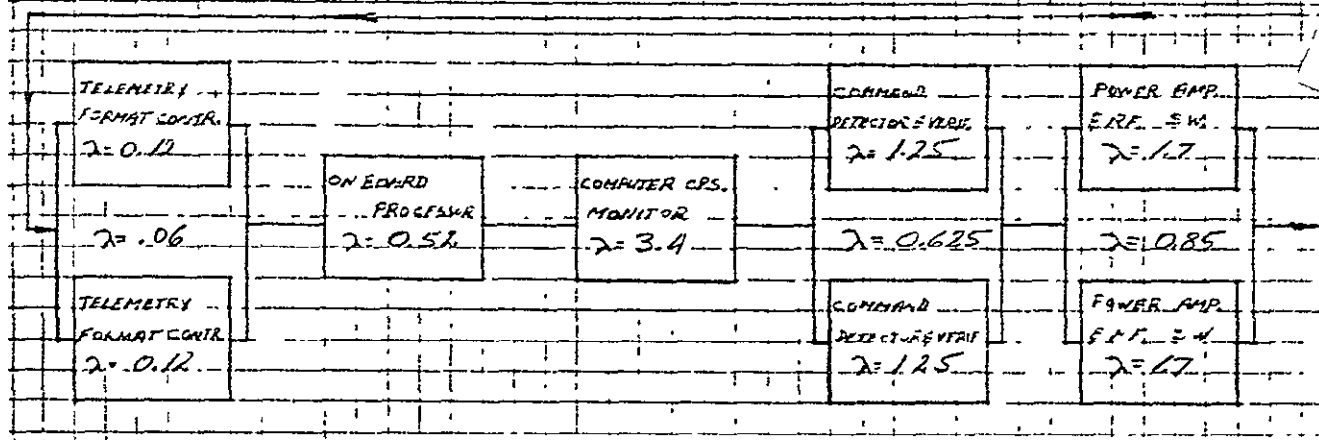

$$\lambda_{\text{SAMPLE DATA}} = 14.5 \text{ VOLTAGES PER } 10^3 \text{ Hz}$$

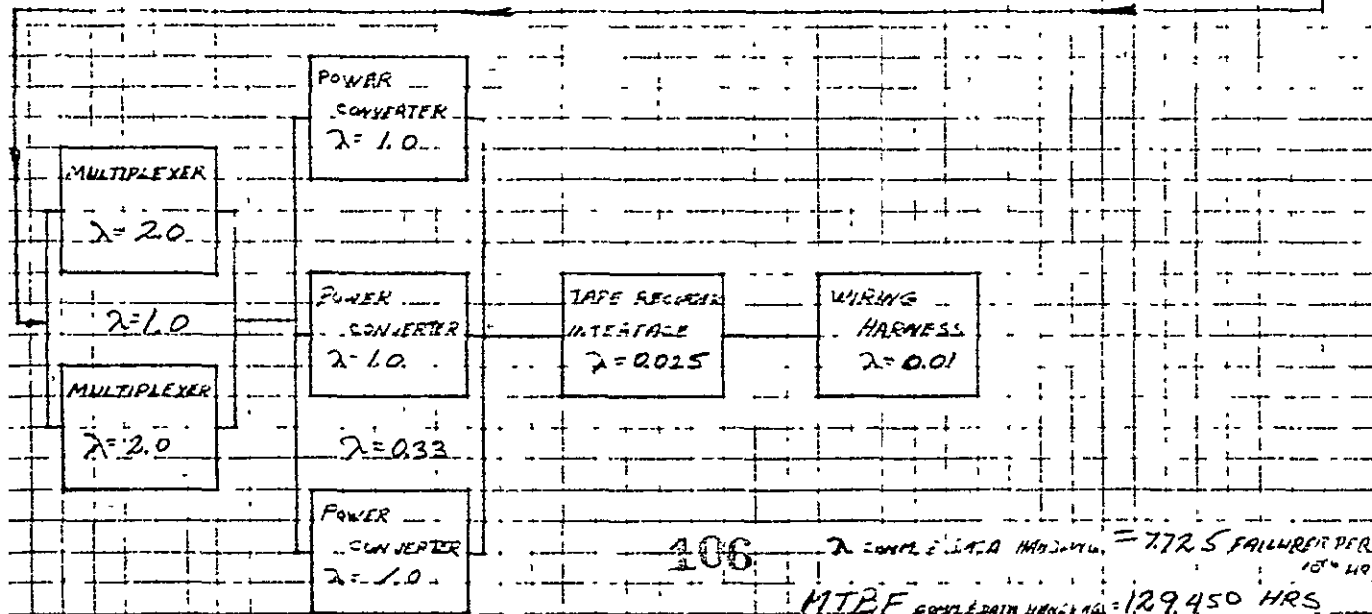
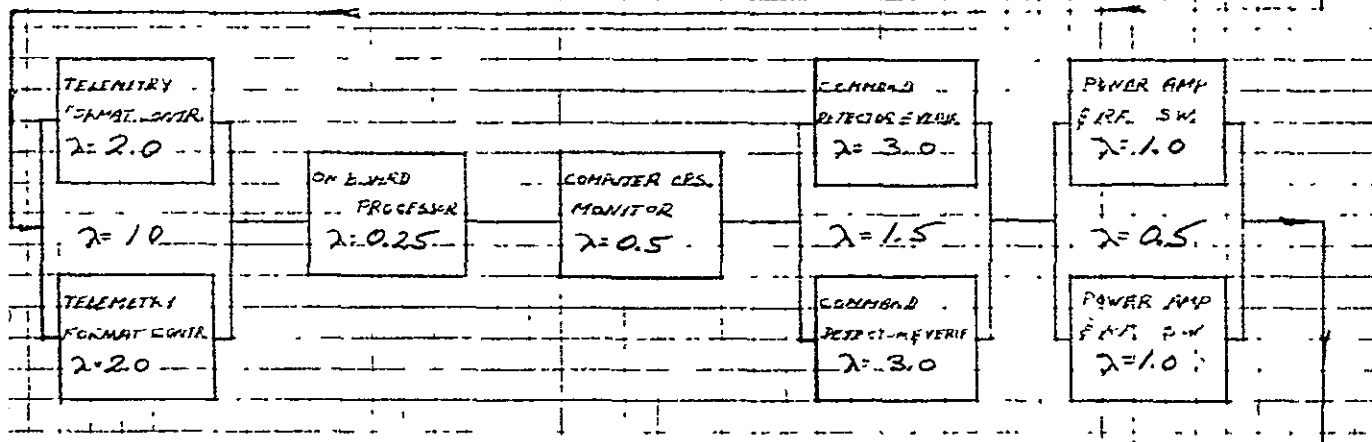
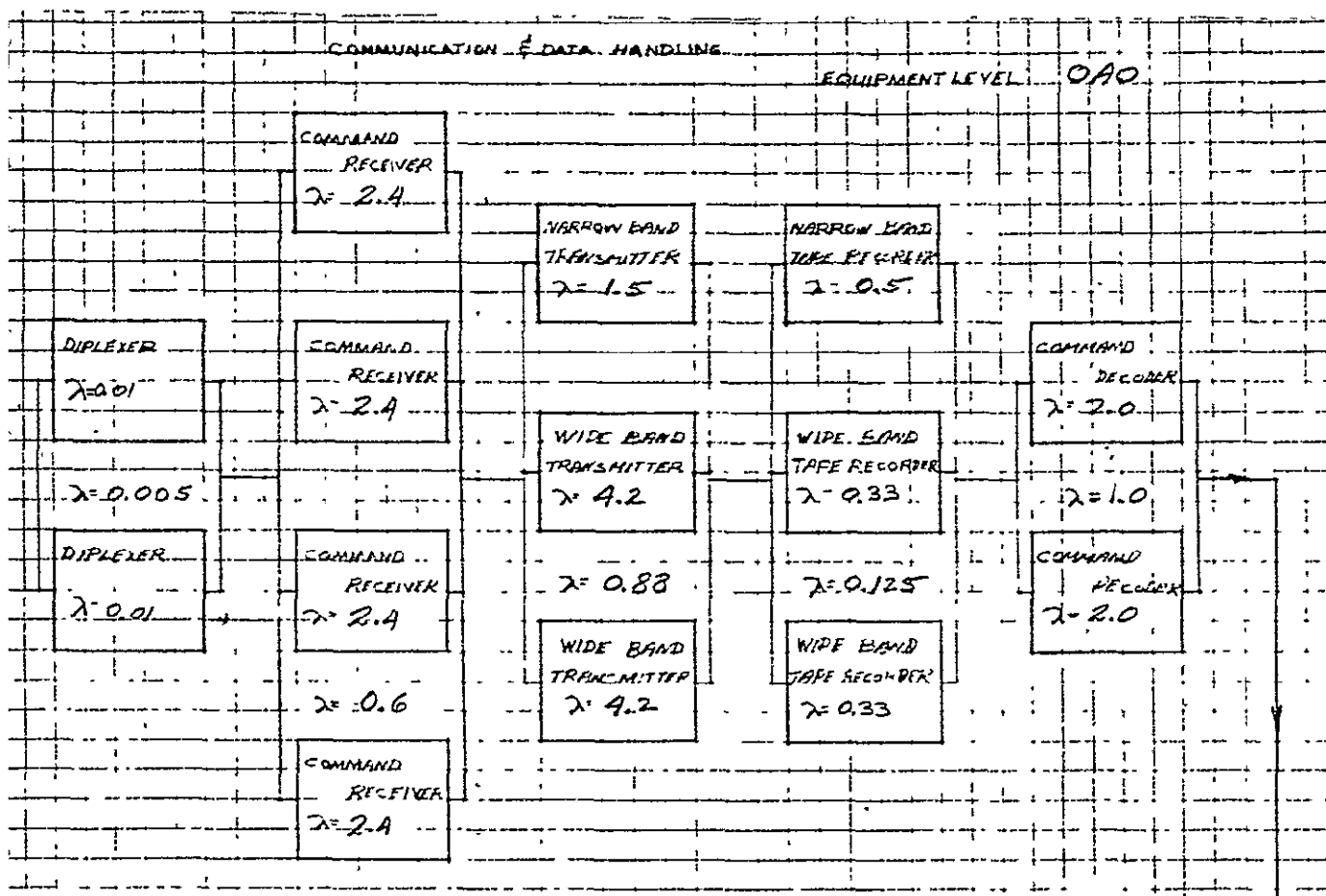
MTBF $\text{GCM \& DATA HANDLING}$ = 68 HRS

ALL 2 ARE IN FAMILIES PER 70⁺ HRS.



NOT REPRODUCIBLE

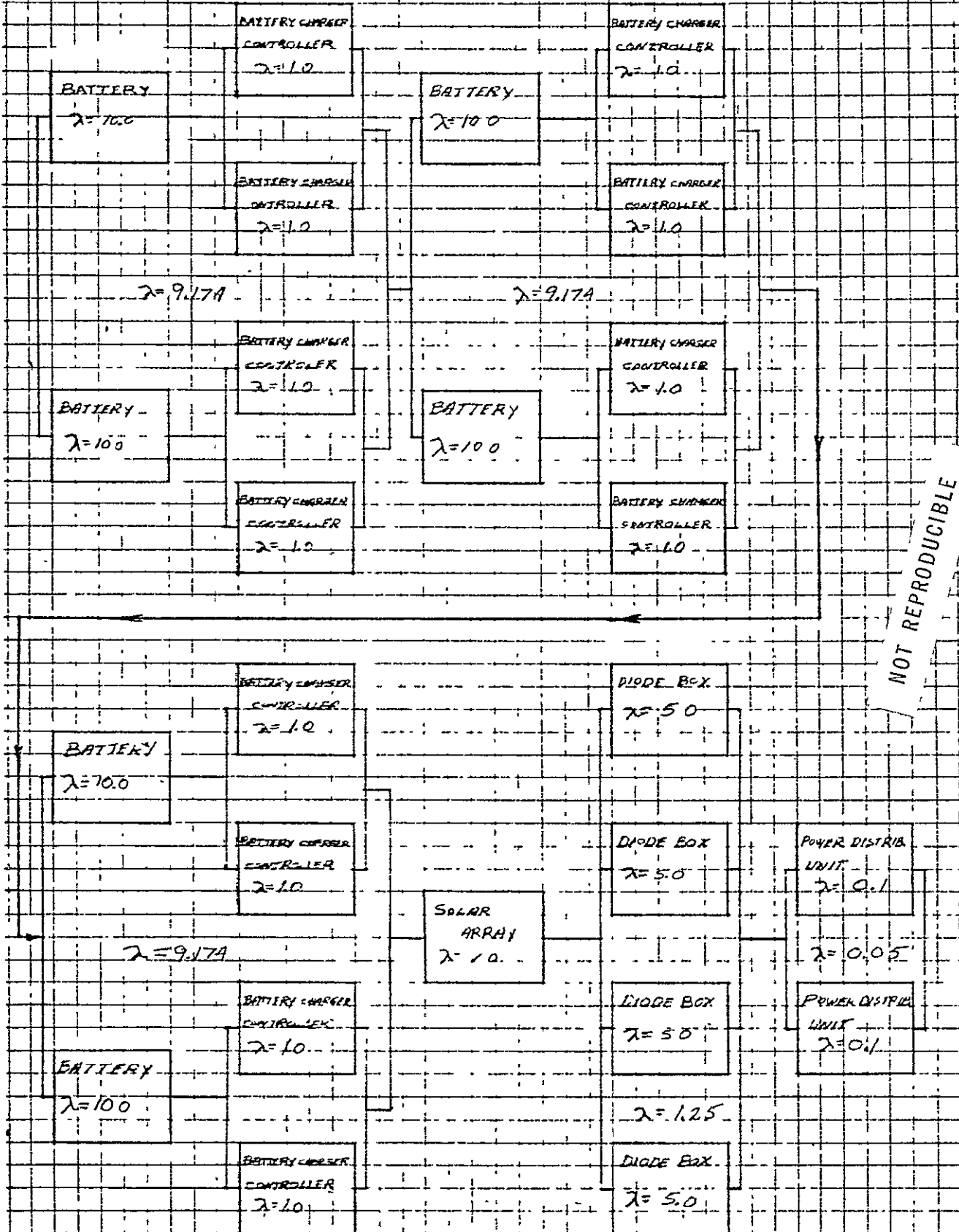
ALL λ ARE IN FAILURES PER 10⁴ HRS



ALL 2 ARE IN FAILURES PER 10^{+6} HRS

ELECTRICAL POWER

EQUIPMENT LEVEL AIRCRAFT



NOT REPRODUCIBLE

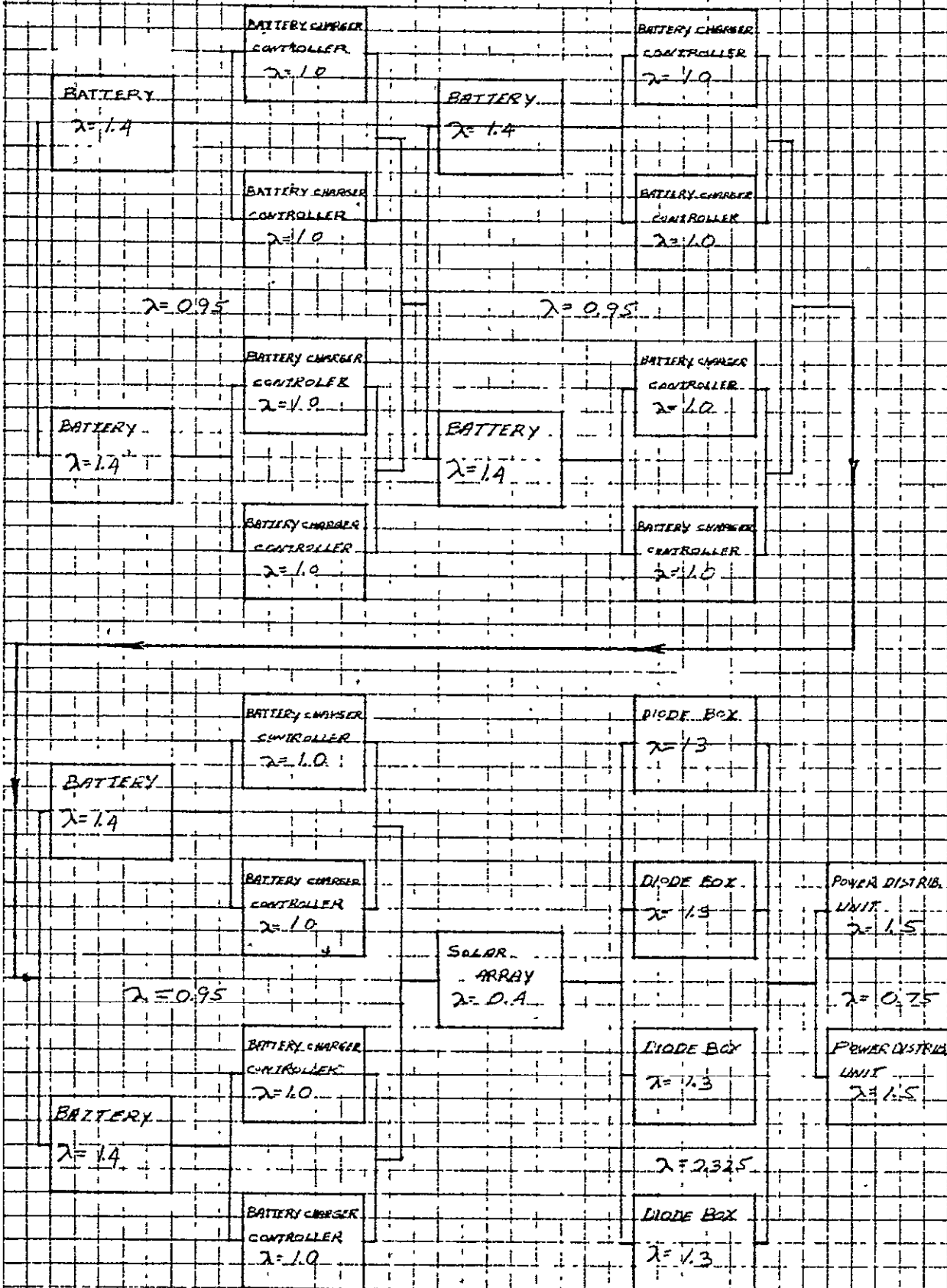
ALL λ ARE IN FAILURES PER 10^3 HRSNET POWER = 29,822 CAULDS PER 10^3 HRS

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MTBF PER 10^3 HRS = 33.5 HRS

ELECTRICAL POWER

EQUIPMENT LEVEL: L. M.



ALL λ ARE IN FAILURES PER 10^6 HRS

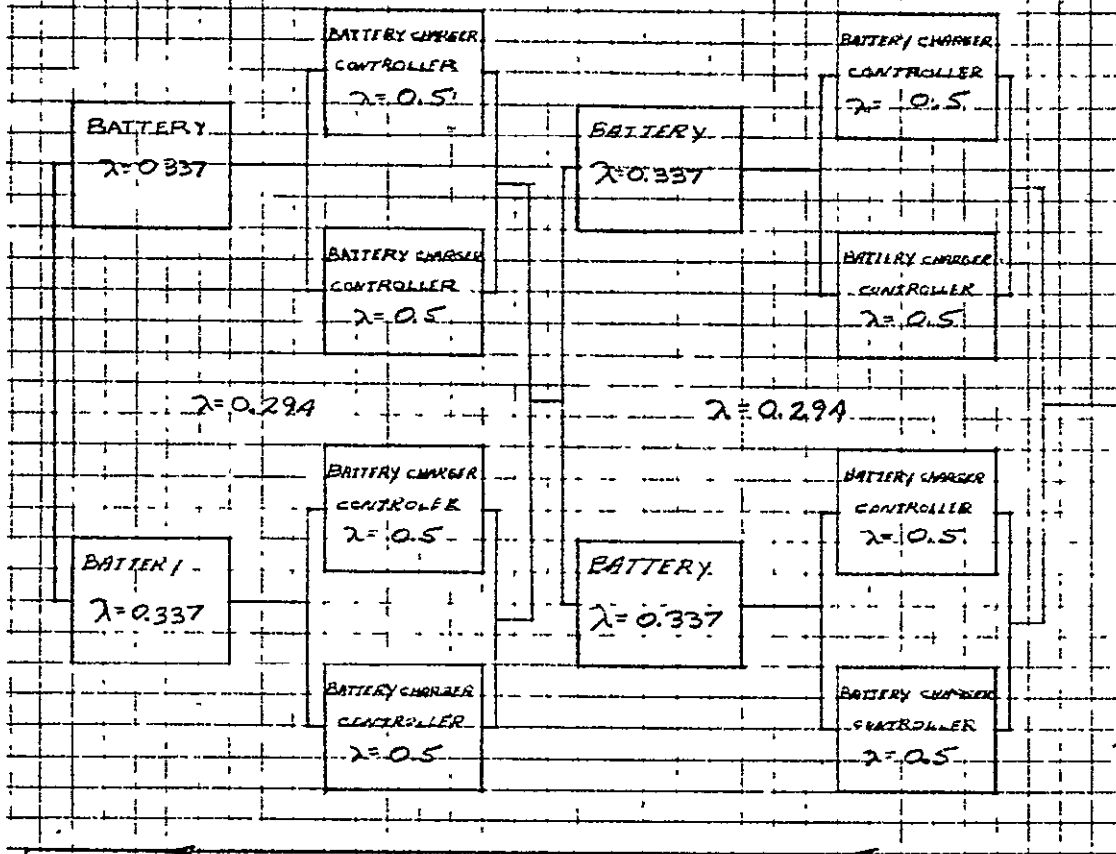
$\lambda_{\text{ELECT. POWER}} = 4.325$ FAILURES PER 10^6 HRS

108

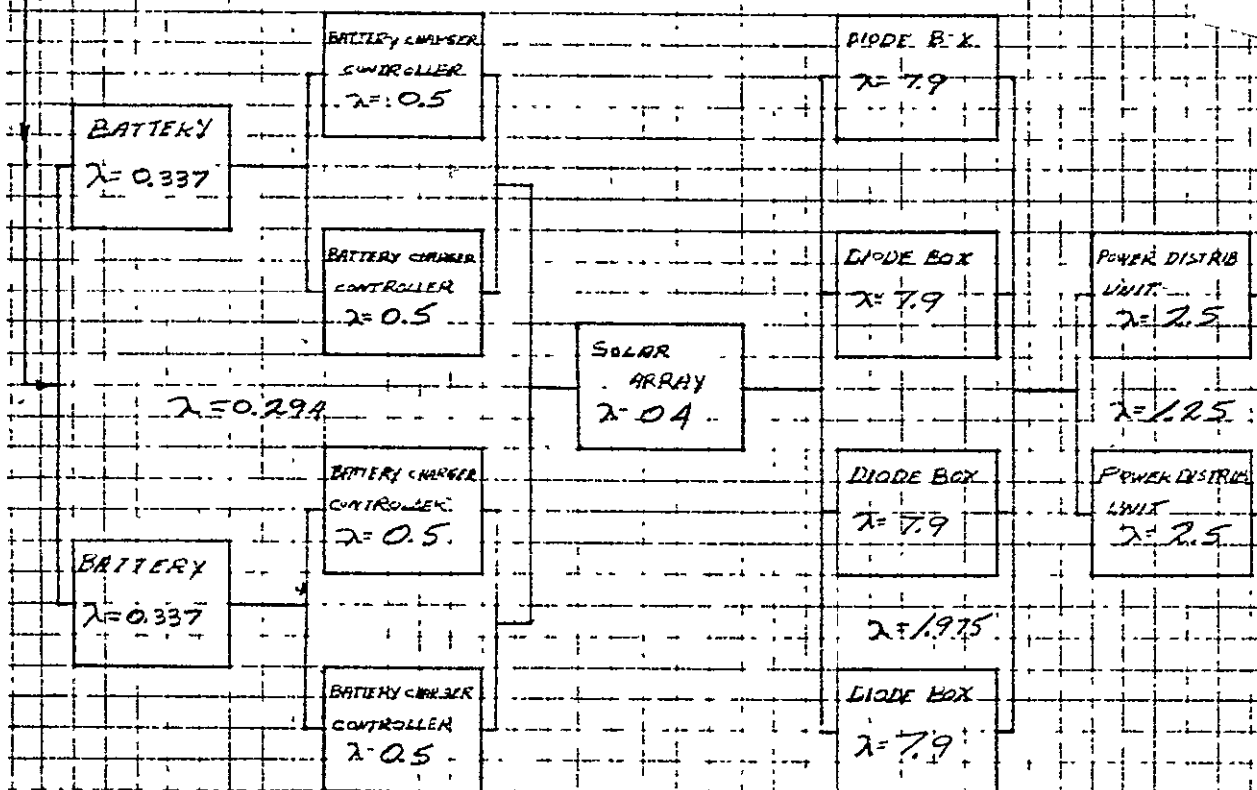
MTBF ELECT. POWER = 231,213

ELECTRICAL POWER

EQUIPMENT LEVEL 0A0



NOT REPRODUCIBLE



ALL λ ARE IN FAILURES PER 10^6 HRS

SELECT POWER = 4.507 FAILURES PER 10^6 HRS

MTBF, SELECT POWER = 221,877 HRS

Appendix Section 4
Cost Model/Analysis Computer Outputs

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PERCOM PROGRAM

PROGRAM NO. 1

SHUTTLE SCHEDULE DELAY, 0.5

TOTAL SYSTEM MTTF..... 3.0

VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED NON-RECURRING RECURRING OPERATIONS

1	STRUCTURE	20150000.	70649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	60062.	1617140.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	28892.	729178.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	167969.	1089890.
9	PNEUMATICS	1214.	235628.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2513000.	7112000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	113800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	592000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	81105520.	68312656.	
G & A	10462607.	8812329.	1160999.
SUBTOTAL	91568112.	77124976.	
NON-G & A SUBTOTAL	14197012.	194863690.	
TOTAL	105765120.	271988480.	10160999.
*NO G & A CHARGE			

TOTAL

387914496.

COST OF ADD'L SHUTTLE REPAIR FLTS

210000000.

GRAND TOTAL

597914368.

NO. OF FAILURES..... 48.00

UPTIME (YEARS)..... 12.00

UPTIME RATIO..... 0.80

PERCOM PROGRAM

PROGRAM NO. 2

SHUTTLE SCHEDULE DELAY.. 1.0

TOTAL SYSTEM MTF..... 3.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	60862.	1617140.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	28892.	729178.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	167869.	1089890.
9	PNEUMATICS	1214.	235628.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448598.
13	RELIABILITY	111600.	111800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

G & A CHARGEABLE

G & A

SUBTOTAL

NON-G & A SUBTOTAL

TOTAL

*NO G & A CHARGE

TOTAL

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 42.00

UPTIME (YEARS)..... 10.50

UPTIME RATIO..... 0.70

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO. 4

SHUTTLE SCHEDULE DELAY... 2.0
 TOTAL SYSTEM MTF..... 3.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	60862.	1617140.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721491.
6	ELECTRONIC POWER	28892.	729178.
7 *	PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	167869.	1089820.
9	PNEUMATICS	1214.	215628.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070674.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448628.
13	RELIABILITY	111600.	111800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16 *	TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19 *	EXPERIMENTS A & B	5000000.	30000000.
20	GROUND STATION	3251000.	800000.
21 *	NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22 *	LV-TITAN	0.0	22500000.
23 *	LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25 *	FACILITIES	1347012.	362826.
26 *	SHUTTLE UPDATE FLIGHT	0.0	15000000.
27 *	EXPERIMENT UPDATE	0.0	79000000.
28 *	G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	81105520.	68312656.	9000000.
	G & A	10462607.	8812329.	1160999.
	SUBTOTAL	91568112.	77124976.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	105765120.	271988440.	10160999.
	*NO G & A CHARGE			

TOTAL

387914496.

COST OF ADD'L SHUTTLE REPAIR FLTS

137999952.

GRAND TOTAL

525914368.

NO. OF FAILURES.... 33.60

UPTIME (YEARS)..... 8.40

UPTIME RATIO..... 0.56

PERCOM PROGRAM

PROGRAM NO. 5

SHUTTLE SCHEDULE DELAY... 2.5

TOTAL SYSTEM MTF..... 3.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	10640216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	60862.	1617140.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	28892.	729178.
7	* PRIMARY OPTICS	3300000.	8000978.
8	COMM. & DATA HANDLING	167969.	1087800.
9	PNEUMATICS	1214.	235628.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449698.
13	RELIABILITY	111600.	113800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

NOT REPRODUCIBLE

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	367826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

9000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	81105520.	68312656.	
G & A	10462607.	8812329.	1160999.
SUBTOTAL	91568112.	77124976.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	105765120.	271984480.	10160999.
*NO G & A CHARGE			

TOTAL

387914496.

COST OF ADD'L SHUTTLE REPAIR FLTS

122727200.

GRAND TOTAL

510641664.

NO. OF FAILURES.... 30.55

UPTIME (YEARS).... 7.64

UPTIME RATIO..... 0.51

PERCOM PROGRAM

PROGRAM NO. 6

SHUTTLE SCHEDULE DELAY... 3.0
TOTAL SYSTEM MTF..... 3.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

		NON-RECURRING	RECURRING	OPERATIONS
1	STRUCTURE	20150000.	30649216.	
2	ENGINEERING	17500000.	2250126.	
3	STABILIZATION	60862.	1617140.	
4	THERMAL	2120000.	2910971.	
5	S-C MECHANISMS	3520000.	2721481.	
6	ELECTRIC POWER	28892.	729178.	
7	* PRIMARY OPTICS	3300000.	8000478.	
8	COMM. & DATA HANDLING	167869.	1087890.	
9	PNEUMATICS	1214.	235629.	
10	TEST & SUPPORT EQUIPMENT	4649540.	2070614.	
11	PROGRAM MANAGEMENT	2533000.	7119000.	
12	SYSTEM INTEGRATION	944000.	2448698.	
13	RELIABILITY	111600.	133900.	
14	QUALITY ACCEPTANCE	1445220.	5820000.	
15	TITAN INTERSTAGE	5820000.	670000.	
16	* TITAN SHROUD	0.0	1000000.	
17	SHUTTLE INTERFACES	20910000.	1997000.	
18	TRAINERS & SIMULATORS	3110400.	100000.	
19	* EXPERIMENTS A & B	5000000.	39000000.	
20	GROUND STATION	3251000.	800000.	
21	* NEW COMPUTERS	4550000.	0.0	

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.	
23	* LV-SHUTTLE	0.0	10000000.	
24	S-C SUPPORT	0.0	4950000.	
25	* FACILITIES	1347012.	362826.	
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.	
27	* EXPERIMENT UPDATE	0.0	39000000.	
28	* G.S.F.C. & OTHER	0.0	60000000.	

9000000.

ORBITAL OPERATIONS

G & A CHARGEABLE	81105520.	68312656.	
G & A	10462607.	8912329.	1160999.
SUBTOTAL	91568112.	77124976.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	105765120.	271998480.	10160999.

*NO G & A CHARGE

TOTAL

387914496.

COST OF ADD'L SHUTTLE REPAIR FLTS

110000000.

GRAND TOTAL

497914368.

NO. OF FAILURES.... 28.00

UPTIME (YEARS).... 7.00

UPTIME RATIO..... 0.47

PERCOM PROGRAM

PROGRAM NO. 7

SHUTTLE SCHEDULE DELAY.. 6.0
 TOTAL SYSTEM MTTF..... 3.0
 VAP, SUBSYSTEM MTTF..... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED NON-RECURRING RECURRING OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	60862.	1617140.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	20892.	729178.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	167869.	1089890.
9	PNEUMATICS	1214.	235628.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449698.
13	RELIABILITY	111600.	131900.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1297000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	8000000.
21	* NEW COMPUTERS	4550000.	0.0

NOT REPRODUCIBLE

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	81105520.	68312656.	
G & A	10462607.	8812329.	1160999.
SUBTOTAL	91568112.	77124976.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	105765120.	271988480.	10160999.
*NO G & A CHARGE			

TOTAL

387914496.

COST OF ADD'L SHUTTLE REPAIR FLTS

6333280.

GRAND TOTAL

451247616.

NO. OF FAILURES..... 18.67

UPTIME (YEARS)..... 4.67

UPTIME RATIO..... 0.31

PERCOM PROGRAM

PROGRAM NO. 8

SHUTTLE SCHEDULE DELAY.. 12.0

TOTAL SYSTEM MTF..... 3.0

VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	10649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	60862.	1617140.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	28892.	729178.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	167869.	1089890.
9	PNEUMATICS	1214.	235628.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119030.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	162826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	81105520.	68312656.	
	G & A	10462607.	8812329.	1160999.
	SUBTOTAL	91568112.	77124976.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	105765120.	271988480.	10160999.
	*NO G & A CHARGE			

TOTAL

387914496.

25999984.

413914368.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 11.20

UPTIME (YEARS)..... 2.80

UPTIME RATIO..... 0.19

PERCON PROGRAM

PROGRAM NO. 9

SHUTTLE SCHEDULE DELAY.. 24.0

TOTAL SYSTEM MTF..... 3.0

VAR. SUBSYSTEM SLOPE, , , 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED NON-RECURRING RECURRING OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	60862.	1617140.
4	THERMAL	2120000.	2710971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	28092.	729178.
7	* PRIMARY OPTICS	3300000.	8000978.
8	COMM. & DATA HANDLING	167869.	1080890.
9	PNEUMATICS	1214.	235628.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	141800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	81105520.	6812656.	9000000.
	G & A	10462607.	8812329.	1160999.
	SUBTOTAL	91568112.	77124976.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	105765120.	271988480.	10160999.
	*NO G & A CHARGE			

TOTAL

387914496.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

387914496.

NO. OF FAILURES.... 6.22

UPTIME (YEARS).... 1.56

UPTIME RATIO..... 0.10

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.10

SHUTTLE SCHEDULE DELAY... 0.5
 TOTAL SYSTEM MTTF..... 6.0
 VAR. SUBSYSTEM SLOPE... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

	NON-RECURRING	RECURRING	OPERATIONS
1 STRUCTURE	20150000.	30649216.	
2 ENGINEERING	17500000.	2250126.	
3 STABILIZATION	211309.	5614659.	
4 THERMAL	2120000.	2910971.	
5 S-C MECHANISMS	3520000.	2721493.	
6 ELECTRIC POWER	100312.	2531682.	
7 * PRIMARY OPTICS	3100000.	8000878.	
8 COMM. & DATA HANDLING	582836.	3784059.	
9 PNEUMATICS	4215.	810092.	
10 TEST & SUPPORT EQUIPMENT	4669540.	2070634.	
11 PROGRAM MANAGEMENT	2533000.	7119000.	*
12 SYSTEM INTEGRATION	944000.	2448698.	
13 RELIABILITY	111600.	111500.	
14 QUALITY ACCEPTANCE	1445220.	5820000.	
15 TITAN INTERSTAGE	582000.	670000.	
16 * TITAN SHROUD	0.0	1000000.	
17 SHUTTLE INTERFACES	2091000.	1927000.	
18 TRAINERS & SIMULATORS	3110400.	100000.	
19 * EXPERIMENTS A & B	5000000.	39000000.	
20 GROUND STATION	3251000.	800000.	
21 * NEW COMPUTERS	4550000.	0.0	

LAUNCH OPERATIONS

	NON-RECURRING	RECURRING	OPERATIONS
22 * LV-TITAN	0.0	22500000.	
23 * LV-SHUTTLE	0.0	10000000.	
24 S-C SUPPORT	0.0	4950000.	
25 * FACILITIES	1347012.	362826.	
26 * SHUTTLE UPDATE FLIGHT	0.0	15000000.	
27 * EXPERIMENT UPDATE	0.0	39000000.	
28 * G.S.F.C. & OTHER	0.0	60000000.	

9000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE

G & A

SUBTOTAL

NON-G & A SUBTOTAL

TOTAL

*NO G & A CHARGE

81745376.

10545149.

92290512.

14197012.

106487520.

77189312.

9983217.

87372528.

194863680.

282236160.

398884352.

99230720.

498115072.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 25.85

UPTIME (YEARS)..... 12.92

UPTIME RATIO..... 0.86

PERCOM PROGRAM

PROGRAM NO. 11

SHUTTLE SCHEDULE DELAY... 1.0

TOTAL SYSTEM MTF..... 6.0

VAR. SUBSYSTEM SLOPE... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2260126.
3	STABILIZATION	211709.	5614659.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721487.
6	ELECTRIC POWER	100712.	2531692.
7	* PRIMARY OPTICS	3700000.	8000878.
8	COMM. & DATA HANDLING	582836.	3784059.
9	PNEUMATICS	4215.	818092.
10	TEST & SUPPORT EQUIPMENT	4660540.	2070674.
11	PROGRAM MANAGEMENT	2531000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449698.
13	RELIABILITY	111600.	137800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1907000.
18	TRAINERS & SIMULATORS	3110400.	10000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	762826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	81745376.	77189712.	90000000.
	G & A	10545149.	9987217.	1160999.
	SUBTOTAL	92290512.	87172529.	
	NON-G & A SUBTOTAL	14197012.	194867680.	
	TOTAL	106487520.	282236160.	10160999.
	*NO G & A CHARGE			

TOTAL

398884352.

COST OF ADD'L SHUTTLE REPAIR FLTS

90000000.

GRAND TOTAL

488884224.

NO. OF FAILURES... 24.00

UPTIME (YEARS)..... 12.00

UPTIME RATIO..... 0.80

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.12

SHUTTLE SCHEDULE DELAY.. 1.5
 TOTAL SYSTEM MTTF..... 6.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	211309.	5614659.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	100312.	2511692.
7	* PRIMARY OPTICS	3100000.	8000878.
8	COMM. & DATA HANDLING	582816.	3784059.
9	PNEUMATICS	4215.	814092.
10	TEST & SUPPORT EQUIPMENT	4569540.	2070634.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	762826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	81745376.	77389312.	9000000.
	G & A	10545149.	9983217.	1160999.
	SUBTOTAL	92290512.	87372528.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	106487520.	282236160.	10160999.
	*NO G & A CHARGE			

TOTAL

398884352.

COST OF ADD'L SHUTTLE REPAIR FLTS

81999968.

GRAND TOTAL

480884224.

NO. OF FAILURES.... 22.40

UPTIME (YEARS)..... 11.20

UPTIME RATIO..... 0.75

PERCOM PROGRAM

PROGRAM NO.13

SHUTTLE SCHEDULE DELAY... 2.0
 TOTAL SYSTEM MTF..... 6.0
 VAR. SUBSYSTEM SLOPE... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30640216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	211309.	5614659.
4	THERMAL	21200000.	2910971.
5	S-C MECHANISMS	3520000.	2721443.
6	ELECTRIC POWER	100312.	2511692.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	582836.	3784059.
9	PNEUMATICS	4215.	814092.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	131800.
14	QUALITY ACCEPTANCE	1445220.	5920000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

9000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	81745376.	77389312.
	G & A	10545149.	9983217.
	SUBTOTAL	92290512.	87372528.
	NON-G & A SUBTOTAL	14197012.	194863680.
	TOTAL	106487520.	282236160.

10160999.

*NO G & A CHARGE

TOTAL

398884352.

75000000.

473884160.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 21.00

UPTIME (YEARS)..... 10.50

UPTIME RATIO..... 0.70

PERCOM PROGRAM

PROGRAM NO. 14

SHUTTLE SCHEDULE DELAY... 2.5
TOTAL SYSTEM MTF..... 6.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	211309.	5614659.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721493.
6	ELECTRIC POWER	100312.	2511682.
7	* PRIMARY OPTICS	3300000.	8000978.
8	COMM. & DATA HANDLING	582816.	3784059.
9	PNEUMATICS	4215.	818092.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133400.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

NOT REPRODUCIBLE

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	* S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

9000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	81745376.	77189312.	
	G & A	10545149.	9981217.	1160999.
	SUBTOTAL	92290512.	87172528.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	106487520.	282236160.	10160999.
	*NO G & A CHARGE			

TOTAL

398884352.

68823456.

467707648.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 19.76

UPTIME (YEARS)..... 9.88

UPTIME RATIO..... 0.66

PERCOM PROGRAM

PROGRAM NO.15

SHUTTLE SCHEDULE DELAY... 3.0

TOTAL SYSTEM MTF..... 6.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED NON-RECURRING RECURRING OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	211309.	5614659.
4	THERMAL	2120000.	2910471.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	100312.	2531642.
7	* PRIMARY OPTICS	3100000.	4000979.
8	COMM. & DATA HANDLING	582836.	3784059.
9	PNEUMATICS	4215.	818092.
10	TEST & SUPPORT EQUIPMENT	4660540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448694.
13	RELIABILITY	111600.	131800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1147012.	362825.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	81745376.	77389312.	
G & A	10545149.	9093217.	1160999.
SUBTOTAL	92290512.	87372528.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	106487520.	282236160.	10160999.
*NO G & A CHARGE			

TOTAL

398884352.

COST OF ADD'L SHUTTLE REPAIR FLTS
GRAND TOTAL

63333280.

462217472.

NO. OF FAILURES.... 18.67

UPTIME (YEARS)..... 9.33

UPTIME RATIO..... 0.62

PERCOM PROGRAM

PROGRAM NO.16

SHUTTLE SCHEDULE DELAY... 6.0
TOTAL SYSTEM MTF..... 6.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	211309.	5614659.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	100712.	2571682.
7	* PRIMARY OPTICS	3400000.	8000878.
8	COMM. & DATA HANDLING	582836.	3784059.
9	PNEUMATICS	4215.	818092.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1097000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	30000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1747012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	81745376.	77389312.	90000000.
	G & A	10545149.	9203217.	1160999.
	SUBTOTAL	92290512.	87372528.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	106487520.	282236160.	10160999.
	*NO G & A CHARGE			

TOTAL

398884352.

COST OF ADD'L SHUTTLE REPAIR FLTS

40000000.

GRAND TOTAL

438884352.

NO. OF FAILURES.... 14.00

UPTIME (YEARS)..... 7.00

UPTIME RATIO..... 0.47

PERCOM PROGRAM

PROGRAM NO.17

SHUTTLE SCHEDULE DELAY... 12.0
TOTAL SYSTEM MTF..... 6.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250128.
3	STABILIZATION	211309.	5614659.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	100312.	2531682.
7 *	PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	582836.	3784059.
9	PNEUMATICS	4215.	818092.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2573000.	7110000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133900.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16 *	TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19 *	EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21 *	NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22 *	LV-TITAN	0.0	22500000.
23 *	LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25 *	FACILITIES	1347012.	362826.
26 *	SHUTTLE UPDATE FLIGHT	0.0	15000000.
27 *	EXPERIMENT UPDATE	0.0	39000000.
28 *	G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

G & A CHARGEABLE	81745376.	77389112.	9000000.
G & A	10545149.	9983217.	1160999.
SUBTOTAL	92290512.	87372528.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	106487520.	282236160.	10160999.
*NO G & A CHARGE			

TOTAL

398884352.

COST OF ADD'L SHUTTLE REPAIR FLTS

16666665.

GRAND TOTAL

415550976.

NO. OF FAILURES.... 9.33

UPTIME (YEARS).... 4.67

UPTIME RATIO..... 0.31

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO. 18

SHUTTLE SCHEDULE DELAY.. 24.0
 TOTAL SYSTEM MTF..... 6.0
 VAR. SUBSYSTEM SLOPE.... 1.25

.....
 SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

	NON-RECURRING	RECURRING	OPERATIONS
1 STRUCTURE	20150000.	30640216.	
2 ENGINEERING	17500000.	2250126.	
3 STABILIZATION	211309.	5614659.	
4 THERMAL	2120000.	2910771.	
5 S-C MECHANISMS	3520000.	2721483.	
6 ELECTRIC POWER	100312.	2531682.	
7 * PRIMARY OPTICS	3100000.	8000878.	
8 COMM. & DATA HANDLING	582836.	3784054.	
9 PNEUMATICS	4215.	818092.	
10 TEST & SUPPORT EQUIPMENT	4660540.	2070614.	
11 PROGRAM MANAGEMENT	2533000.	7119000.	
12 SYSTEM INTEGRATION	944000.	2448598.	
13 RELIABILITY	111600.	131800.	
14 QUALITY ACCEPTANCE	1445220.	5820000.	
15 TITAN INTERSTAGE	582000.	670000.	
16 * TITAN SHROUD	0.0	1000000.	
17 SHUTTLE INTERFACES	20910000.	1997000.	
18 TRAINERS & SIMULATORS	3110400.	100000.	
19 * EXPERIMENTS A & B	5000000.	39000000.	
20 GROUND STATION	3251000.	800000.	
21 * NEW COMPUTERS	4550000.	0.0	

LAUNCH OPERATIONS

	NON-RECURRING	RECURRING	OPERATIONS
22 * LV-TITAN	0.0	22500000.	
23 * LV-SHUTTLE	0.0	10000000.	
24 S-C SUPPORT	0.0	4950000.	
25 * FACILITIES	1347012.	752926.	
26 * SHUTTLE UPDATE FLIGHT	0.0	15000000.	
27 * EXPERIMENT UPDATE	0.0	39000000.	
28 * G.S.F.C. & OTHER	0.0	60000000.	

29 ORBITAL OPERATIONS

	NON-RECURRING	RECURRING	OPERATIONS
G & A CHARGEABLE	81745376.	77389312.	
G & A	10545149.	9983217.	1160999.
SUBTOTAL	92290512.	87172528.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	106487520.	282236160.	10160999.

*NO G & A CHARGE

TOTAL

398884352.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

398884352.

NO. OF FAILURES.... 5.60

UPTIME (YEARS)..... 2.80

UPTIME RATIO..... 0.19

PERCOM PROGRAM

PROGRAM NO.19

SHUTTLE SCHEDULE DELAY... 0.5
TOTAL SYSTEM MTF..... 9.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

	NON-RECURRING	RECURRING
1 STRUCTURE	20150000.	30649216.
2 ENGINEERING	17500000.	2250126.
3 STABILIZATION	450641.	11973990.
4 THERMAL	2120000.	2910971.
5 S-C MECHANISMS	3520000.	2721483.
6 ELECTRIC POWER	213926.	5399098.
7 * PRIMARY OPTICS	3300000.	8000878.
8 COMM. & DATA HANDLING	1242951.	8069922.
9 PNEUMATICS	8988.	1744672.
10 TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11 PROGRAM MANAGEMENT	2533000.	7119000.
12 SYSTEM INTEGRATION	944000.	2448609.
13 RELIABILITY	111600.	111800.
14 QUALITY ACCEPTANCE	1445220.	5820000.
15 TITAN INTERSTAGE	582000.	670000.
16 * TITAN SHROUD	0.0	1000000.
17 SHUTTLE INTERFACES	20910000.	1997000.
18 TRAINERS & SIMULATORS	3110400.	100000.
19 * EXPERIMENTS A, B, C	5000000.	39000000.
20 GROUND STATION	3251000.	800000.
21 * NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22 * LV-TITAN	0.0	22500000.
23 * LV-SHUTTLE	0.0	10000000.
24 S-C SUPPORT	0.0	4950000.
25 * FACILITIES	1347012.	362826.
26 * SHUTTLE UPDATE FLIGHT	0.0	15000000.
27 * EXPERIMENT UPDATE	0.0	30000000.
28 * G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

90000000.

G & A CHARGEABLE	82763232.	91828400.	
G & A	10676452.	11845858.	1160999.
SUBTOTAL	93439680.	103674256.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	107636688.	298537728.	10160999.
*NO G & A CHARGE			

TOTAL

416135104.

COST OF ADD'L SHUTTLE REPAIR FLTS

58421008.

GRAND TOTAL

474756096.

NO. OF FAILURES.... 17.68

UPTIME (YEARS).... 13.26

UPTIME RATIO..... 0.88

PFCOM PROGRAM

PROGRAM NO.20

SHUTTLE SCHEDULE DELAY.. 1.0
 TOTAL SYSTEM MTF..... 9.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	450641.	11973880.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721493.
6	ELECTRIC POWER	213926.	5399099.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	1242961.	8069922.
9	PNEUMATICS	8988.	1744672.
10	TEST & SUPPORT EQUIPMENT	4669540.	2079634.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449699.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	352826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	82763232.	91828400.	
G & A	10676452.	11845858.	1160999.
SUBTOTAL	93439680.	103674256.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	107636688.	298537728.	10160999.
*NO G & A CHARGE			

TOTAL

416335104.

COST OF ADD'L SHUTTLE REPAIR FLTS

53999936.

GRAND TOTAL

470334976.

NO. OF FAILURES.... 16.80

UPTIME (YEARS)..... 12.60

UPTIME RATIO..... 0.84

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO. 21

SHUTTLE SCHEDULE DELAY... 1.5
 TOTAL SYSTEM MTF..... 9.0
 VAR. SUBSYSTEM SLOPE... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	450641.	11073980.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721401.
6	ELECTRIC POWER	213926.	5109098.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	1242961.	8069022.
9	PNEUMATICS	8988.	1744672.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	113800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	762826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	79000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	82763212.	91828400.
G & A	10676452.	11945858.
SUBTOTAL	93439660.	103674256.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	107636688.	298537728.

*NO G & A CHARGE

TOTAL

416335104.

COST OF ADD'L SHUTTLE REPAIR FLTS

50000000.

GRAND TOTAL

466334976.

NO. OF FAILURES.... 15.00

UPTIME (YEARS).... 12.00

UPTIME RATIO..... 0.80

PERCOM PROGRAM

PROGRAM NO.22

SHUTTLE SCHEDULE DELAY.. 2.0
 TOTAL SYSTEM MTF..... 9.0
 VAR. SUBSYSTEM SLOPE.... 1.25

.....
 SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

	NON-RECURRING	RECURRING	OPERATIONS
1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	450641.	11973880.
4	THERMAL	2120000.	2910071.
5	S-C MECHANISMS	3520000.	2721487.
6	ELECTRIC POWER	213926.	5392098.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	1242961.	8069922.
9	PNEUMATICS	8988.	1744672.
10	TEST & SUPPORT EQUIPMENT	4662540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	495000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	82763232.	91428400.	
G & A	10676452.	11845858.	1160999.
SUBTOTAL	93439680.	103674256.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	107636688.	298537728.	10160999.
*NO G & A CHARGE			

TOTAL

416335104.

46363632.

462698496.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 15.27

UPTIME (YEARS)..... 11.45

UPTIME RATIO..... 0.76

NOT REPRODUCIBLE

PERCON PROGRAM

PROGRAM NO.23

SHUTTLE SCHEDULE DELAY.. 2.5
TOTAL SYSTEM MTF..... 9.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	450641.	11973990.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	213926.	5390099.
7	* PRIMARY OPTICS	3300000.	8000879.
8	COMM. & DATA HANDLING	1242961.	8060922.
9	PNEUMATICS	8988.	1744672.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7110000.
12	SYSTEM INTEGRATION	944000.	2449698.
13	RELIABILITY	111600.	131800.
14	QUALITY ACCEPTANCE	1445220.	5920000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	82763232.	91829400.	9000000.
	G & A	10676452.	11845858.	1180999.
	SUBTOTAL	93439680.	103674256.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	107636680.	298537728.	10160999.
	*NO G & A CHARGE			

TOTAL

416335104.

COST OF ADD'L SHUTTLE REPAIR FLTS

43043472.

GRAND TOTAL

459378432.

NO. OF FAILURES.... 14.61

UPTIME (YEARS)..... 10.96

UPTIME RATIO..... 0.73

PERCOM PROGRAM

PROGRAM NO.24

SHUTTLE SCHEDULE DELAY... 3.0
 TOTAL SYSTEM MTE..... 9.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30642216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	450641.	11973480.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	2173226.	5199096.
7	* PRIMARY OPTICS	3100000.	8000878.
8	COMM. & DATA HANDLING	1242961.	8069922.
9	PNEUMATICS	8988.	1744672.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070674.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	82763232.	91828400.	
G & A	10676452.	11845858.	1160999.
SUBTOTAL	93439680.	103674256.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	107636688.	298537728.	10160999.
*NO G & A CHARGE			

TOTAL

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 14.00
 UPTIME (YEARS)..... 10.50
 UPTIME RATIO..... 0.70

416335104.

40000000.

456335104.

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.25

SHUTTLE SCHEDULE DELAY.....6.0

TOTAL SYSTEM MTF.....9.0

VAR. SUBSYSTEM SI OPC.....1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30640216.
2	ENGINEERING	17500000.	2250176.
3	STABILIZATION	450641.	11971880.
4	THERMAL	2120000.	2910071.
5	S-C MECHANISMS	3520000.	2721487.
6	ELECTRIC POWER	213926.	5390009.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	1242961.	8069922.
9	PNEUMATICS	8000.	1744672.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7110000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	162826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	82763212.	91828400.	
	G & A	10676452.	11845858.	1160999.
	SUBTOTAL	93439660.	103674256.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	107636688.	298537728.	10160999.
	*NO G & A CHARGE			

TOTAL

416335104.

COST OF ADD'L SHUTTLE REPAIR FLTS

25999984.

GRAND TOTAL

442334976.

NO. OF FAILURES.....11.20

UPTIME (YEARS).....8.40

UPTIME RATIO.....0.56

PERCOM PROGRAM

PROGRAM NO.26

SHUTTLE SCHEDULE DELAY.. 12.0
 TOTAL SYSTEM MTF..... 9.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	450641.	11973800.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	213926.	5300008.
7	* PRIMARY OPTICS	3700000.	8000878.
8	COMM. & DATA HANDLING	1242961.	8069922.
9	PNEUMATICS	8088.	1744672.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	117400.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	7251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	82763232.	91828400.	9000000.
	G & A	10676452.	11845858.	1160999.
	SUBTOTAL	93439680.	103674256.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	107636680.	298537728.	10160999.
	*NO G & A CHARGE			

TOTAL

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 8.00
 UPTIME (YEARS)..... 6.00
 UPTIME RATIO..... 0.40

416335104.
 10000000.
 426334976.

NOT REPRODUCIBLE

PERCON PROGRAM

PROGRAM NO.27

SHUTTLE SCHEDULE DELAY... 24.0
TOTAL SYSTEM MTF..... 9.0
VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30640216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	450641.	11973880.
4	THERMAL	2120000.	2910071.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	213926.	5390090.
7	* PRIMARY OPTICS	3100000.	8000878.
8	COMM. & DATA HANDLING	1242961.	8060922.
9	PNEUMATICS	8988.	1744672.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7110000.
12	SYSTEM INTEGRATION	944000.	2440609.
13	RELIABILITY	111600.	131800.
14	QUALITY ACCEPTANCE	1445220.	5920000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	79000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	82763232.	91828400.	90000000.
	G & A	10674452.	11845824.	1160999.
	SUBTOTAL	93439680.	103674256.	
	NON-G & A SUBTOTAL	14197012.	194861600.	
	TOTAL	107636688.	29843728.	10160999.
	*NO G & A CHARGE			

TOTAL

416335104.

0.0

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

416335104.

NO. OF FAILURES.... 5.09

UPTIME (YEARS).... 3.82

UPTIME RATIO..... 0.25

PERCOM PROGRAM

PROGRAM NO.2A

SHUTTLE SCHEDULE DELAY... 0.5

TOTAL SYSTEM MTF..... 12.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30640216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	770620.	20475984.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	365926.	9212755.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	2125532.	13800008.
9	PNEUMATICS	15370.	2983483.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7117000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	131800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	542000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	84124048.	111131056.	9000000.
	G & A	10851997.	14336158.	1160999.
	SUBTOTAL	94976032.	125469200.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	109173040.	320332800.	10160999.
	*NO G & A CHARGE			

TOTAL

439666688.

COST OF ADD'L SHUTTLE REPAIR FLTS

37199984.

GRAND TOTAL

476866560.

NO. OF FAILURES.... 13.44

UPTIME (YEARS)..... 13.44

UPTIME RATIO..... 0.90

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.29

SHUTTLE SCHEDULE DELAY, 1.0
TOTAL SYSTEM MTF, 12.0
VAR. SUBSYSTEM SLOPE, 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	70649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	770620.	20475984.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	365826.	9242755.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	2125532.	13800008.
9	PNEUMATICS	15370.	2983483.
10	TEST & SUPPORT EQUIPMENT	4869540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000200.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	30000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	30000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	84124048.	111133056.	90000000.
	G & A	10851997.	14336158.	11609999.
	SUBTOTAL	94976032.	125469200.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	109173040.	320332800.	101609999.
	*NO G & A CHARGE			

TOTAL

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES, 12.92

UPTIME (YEARS), 12.92

UPTIME RATIO, 0.86

439666688.

34615376.

474281984.

PERCOM PROGRAM

PROGRAM NO. 30

SHUTTLE SCHEDULE DELAY.. 1.5
 TOTAL SYSTEM MTF..... 12.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	770620.	20475984.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	365826.	9232755.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	2125532.	13800008.
9	PNEUMATICS	15370.	2983483.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111500.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	84124048.	111133056.
G & A	10851997.	14336158.
SUBTOTAL	94976032.	125469200.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	109173040.	320332800.
*NO G & A CHARGE		

TOTAL

439666680.

COST OF ADD'L SHUTTLE REPAIR FLTS

32222208.

GRAND TOTAL

471888888.

NO. OF FAILURES.... 12.44

UPTIME (YEARS)..... 12.44

UPTIME RATIO..... 0.83

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.31

SHUTTLE SCHEDULE DELAY... 2.0
 TOTAL SYSTEM MTF..... 12.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	10649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	770620.	20475984.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	365826.	9232755.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	2125512.	13000000.
9	PNEUMATICS	15370.	2981483.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449698.
13	RELIABILITY	111600.	133900.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

9000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	84124048.	111133056.
G & A	10851997.	14336158.
SUBTOTAL	94976045.	125469200.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	109173040.	320332800.
*NO G & A CHARGE		

10160999.

TOTAL

439666688.

30000000.

COST OF ADD'L SHUTTLE REPAIR FLTS

469666560.

GRAND TOTAL

NO. OF FAILURES.... 12.00

UPTIME (YEARS).... 12.00

UPTIME RATIO..... 0.80

PERCOM PROGRAM

PROGRAM NO.32

SHUTTLE SCHEDULE DELAY.. 2.5
TOTAL SYSTEM MTF..... 12.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	770620.	20475984.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721441.
6	ELECTRIC POWER	365826.	9232755.
7	* PRIMARY OPTICS	3300000.	8000874.
8	COMM. & DATA HANDLING	2125532.	13800008.
9	PNEUMATICS	15370.	2983481.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070434.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448688.
13	RELIABILITY	111600.	131800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

G & A CHARGEABLE	84124048.	111137056.
G & A	10851997.	14336159.
SUBTOTAL	94976032.	125469200.
NON-G & A SUBTOTAL	14197012.	194867680.
TOTAL	109173040.	320332800.
*NO G & A CHARGE		

TOTAL

439666688.

COST OF ADD'L SHUTTLE REPAIR FLTS

27931024.

GRAND TOTAL

467597568.

NO. OF FAILURES.... 11.59

UPTIME (YEARS)..... 11.59

UPTIME RATIO..... 0.77

PERCOM PROGRAM

PROGRAM NO.33

SHUTTLE SCHEDULE DELAY... 3.0

TOTAL SYSTEM MTTF..... 12.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	770620.	20475084.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	365826.	9212755.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	2125532.	13900008.
9	PNEUMATICS	15370.	2981491.
10	TEST & SUPPORT EQUIPMENT	4660540.	2070614.
11	PROGRAM MANAGEMENT	2531000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449699.
13	RELIABILITY	111600.	133400.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

9000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	84124048.	111131056.
	G & A	10851997.	14336158.
	SUBTOTAL	94976032.	125469200.
	NON-G & A SUBTOTAL	14197012.	194863600.
	TOTAL	109173040.	320332800.

10160999.

*NO G & A CHARGE

TOTAL

439666688.

25999984.

COST OF ADD'L SHUTTLE REPAIR FLTS

465666560.

GRAND TOTAL

NO. OF FAILURES.... 11.20

UPTIME (YEARS).... 11.20

UPTIME RATIO..... 0.75

PERCOM PROGRAM

PROGRAM NO. 34

SHUTTLE SCHEDULE DELAY... 6.0
 TOTAL SYSTEM MYTF..... 12.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

	NON-RECURRING	RECURRING	OPERATIONS
1 STRUCTURE	20150000.	30649216.	
2 ENGINEERING	17500000.	2250126.	
3 STABILIZATION	770620.	20475984.	
4 THERMAL	2120000.	2910971.	
5 S-C MECHANISMS	3520000.	2721483.	
6 ELECTRIC POWER	365826.	9232755.	
7 * PRIMARY OPTICS	3300000.	8000478.	
8 COMM. & DATA HANDLING	2125532.	13800009.	
9 PNEUMATICS	15370.	2983443.	
10 TEST & SUPPORT EQUIPMENT	4669540.	2070634.	
11 PROGRAM MANAGEMENT	2513000.	7119000.	
12 SYSTEM INTEGRATION	944000.	2448698.	
13 RELIABILITY	111600.	133800.	
14 QUALITY ACCEPTANCE	1445220.	5820000.	
15 TITAN INTERSTAGE	582000.	670000.	
16 * TITAN SHROUD	0.0	1000000.	
17 SHUTTLE INTERFACES	20910000.	1997000.	
18 TRAINERS & SIMULATORS	3110400.	100000.	
19 * EXPERIMENTS A & B	5000000.	39000000.	
20 GROUND STATION	3251000.	800000.	
21 * NEW COMPUTERS	4550000.	0.0	

LAUNCH OPERATIONS

22 * LV-TITAN	0.0	22500000.	
23 * LV-SHUTTLE	0.0	10000000.	
24 S-C SUPPORT	0.0	4950000.	
25 * FACILITIES	1347012.	362826.	
26 * SHUTTLE UPDATE FLIGHT	0.0	15000000.	
27 * EXPERIMENT UPDATE	0.0	39000000.	
28 * G.S.F.C. & OTHER	0.0	60000000.	

9000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	84124048.	111133056.	
G & A	10851997.	14336158.	1160999.
SUBTOTAL	94976032.	125469200.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	109173040.	320332800.	10160999.
*NO G & A CHARGE			

TOTAL

439666688.

16666665.

45633312.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 0.33

UPTIME (YEARS).... 9.33

UPTIME RATIO..... 0.62

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.35

SHUTTLE SCHEDULE DELAY, 12.0
 TOTAL SYSTEM MTTF..... 12.0
 VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	770620.	20475984.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	365926.	9232755.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	2125532.	11000000.
9	PNEUMATICS	15370.	2983487.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448624.
13	RELIABILITY	111600.	113000.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	84124048.	111133056.
G & A	10851997.	14336158.
SUBTOTAL	94976042.	125469200.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	109173040.	320332800.
*NO G & A CHARGE		

TOTAL

439666688.

COST OF ADD'L SHUTTLE REPAIR FLTS

5000000.

GRAND TOTAL

444666624.

NO. OF FAILURES..... 7.00

UPTIME (YEARS)..... 7.00

UPTIME RATIO..... 0.47

PERCOM PROGRAM

PROGRAM NO.36

SHUTTLE SCHEDULE DELAY... 24.0

TOTAL SYSTEM MTTF..... 12.0

VAP. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30549216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	770620.	20475984.
4	THERMAL	2120000.	2210271.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	365826.	9212765.
7	* PRIMARY OPTICS	3100000.	8000878.
8	COMM. & DATA HANDLING	2125512.	13800008.
9	PNEUMATICS	15370.	2083483.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2513000.	7110000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	137400.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	30000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	19000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE

84124048.

111133056.

G & A

10851997.

14736158.

1160999.

SUBTOTAL

94976032.

125469200.

NON-G & A SUBTOTAL

14197012.

194863680.

TOTAL

109173040.

320332800.

10160999.

*NO G & A CHARGE

TOTAL

439666688.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

439666688.

NO. OF FAILURES.... 4.67

UPTIME (YEARS).... 4.67

UPTIME RATIO..... 0.31

PERCOM PROGRAM

PROGRAM NO. 17

SHUTTLE SCHEDULE DELAY... 0.5
TOTAL SYSTEM MTF..... 15.0
VAR. SUBSYSTEM SLOPE... 1.25

SHUTTLE-MAINTAINED PROGRAM

(1 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1162441.	30986976.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721881.
6	ELECTRIC POWER	551829.	13927137.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	3206258.	20816609.
9	PNEUMATICS	23185.	4500433.
10	TEST & SUPPORT EQUIPMENT	4569540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	133400.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	85790412.	134772000.	9000000.
	G & A	11066961.	17385568.	1160999.
	SUBTOTAL	96857392.	152157568.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	111054400.	347021056.	10160999.
	*NO G & A CHARGE			

TOTAL

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 10.84
UPTIME (YEARS)..... 13.55
UPTIME RATIO..... 0.90

NOT REPRODUCIBLE

468236288.

24193536.

492429924.

PERCON PROGRAM

PROGRAM NO.38

SHUTTLE SCHEDULE DELAY.. 1.0
TOTAL SYSTEM MTF..... 15.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

		NON-RECURRING	RECURRING	OPERATIONS
1	STRUCTURE	20150000.	30649216.	
2	ENGINEERING	17500000.	2250126.	
3	STABILIZATION	1162441.	30886976.	
4	THERMAL	2120000.	2910971.	
5	S-C MECHANISMS	3520000.	2721483.	
6	ELECTRIC POWER	551829.	13927137.	
7	* PRIMARY OPTICS	3100000.	8000878.	
8	COMM. & DATA HANDLING	3206258.	20815608.	
9	PNEUMATICS	23185.	4500413.	
10	TEST & SUPPORT EQUIPMENT	4660540.	2070634.	
11	PROGRAM MANAGEMENT	2533000.	7119000.	
12	SYSTEM INTEGRATION	944000.	2448698.	
13	RELIABILITY	111600.	113800.	
14	QUALITY ACCEPTANCE	1445220.	5820000.	
15	TITAN INTERSTAGE	582000.	670000.	
16	* TITAN SHROUD	0.0	1000000.	
17	SHUTTLE INTERFACES	20910000.	1997000.	
18	TRAINERS & SIMULATORS	3110400.	100000.	
19	* EXPERIMENTS A & B	5000000.	39000000.	
20	GROUND STATION	3251000.	800000.	
21	* NEW COMPUTERS	4550000.	0.0	

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.	
23	* LV-SHUTTLE	0.0	10000000.	
24	S-C SUPPORT	0.0	4950000.	
25	* FACILITIES	1347012.	362826.	
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.	
27	* EXPERIMENT UPDATE	0.0	39000000.	
28	* G.S.F.C. & OTHER	0.0	60000000.	

ORBITAL OPERATIONS

29	G & A CHARGEABLE	85790432.	134772000.	9000000.
	G & A	11066961.	17185568.	1160999.
	SUBTOTAL	96857392.	152157568.	
	NON-G & A SUBTOTAL	14197012.	194863600.	
	TOTAL	111054400.	347021056.	10160999.
	*NO G & A CHARGE			

TOTAL

468236288.

22500000.

490736128.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 10.50

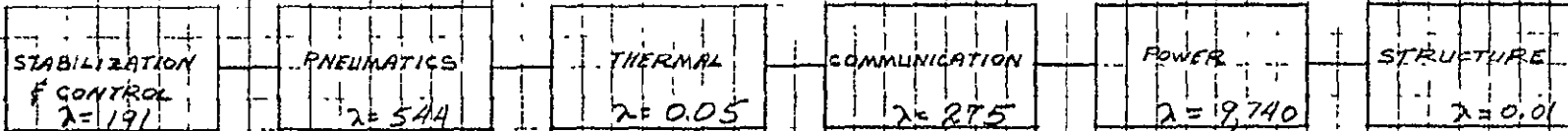
UPTIME (YEARS)..... 13.12

UPTIME RATIO..... 0.88

GROUP LEVEL FAILURE RATE ANALYSIS

GROUP A:

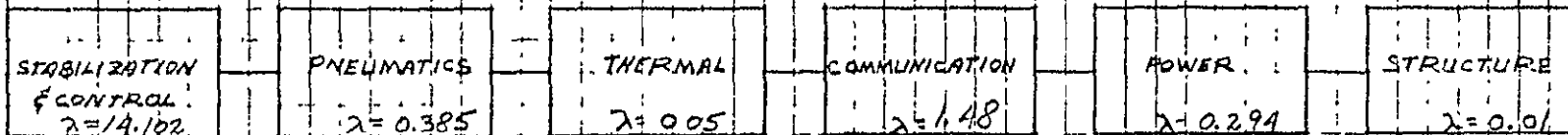
* AIRCRAFT



$$* \lambda_{\text{AIRCRAFT}} = 10750$$

$$MTBF_{\text{AIRCRAFT}} = 93 \text{ HRS}$$

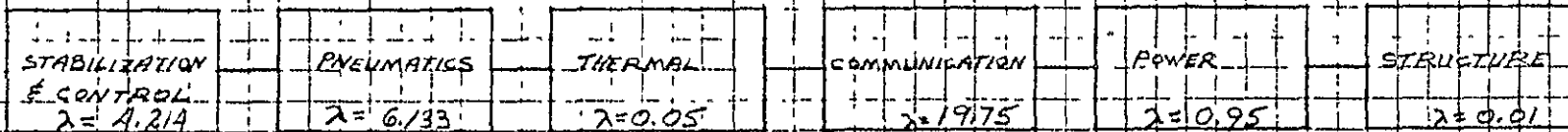
* OAO



$$\lambda_{\text{OAO}} = 16.321$$

$$MTBF_{\text{OAO}} = 61.279 \text{ HRS}$$

* LM



$$\lambda_{\text{LM}} = 31.107$$

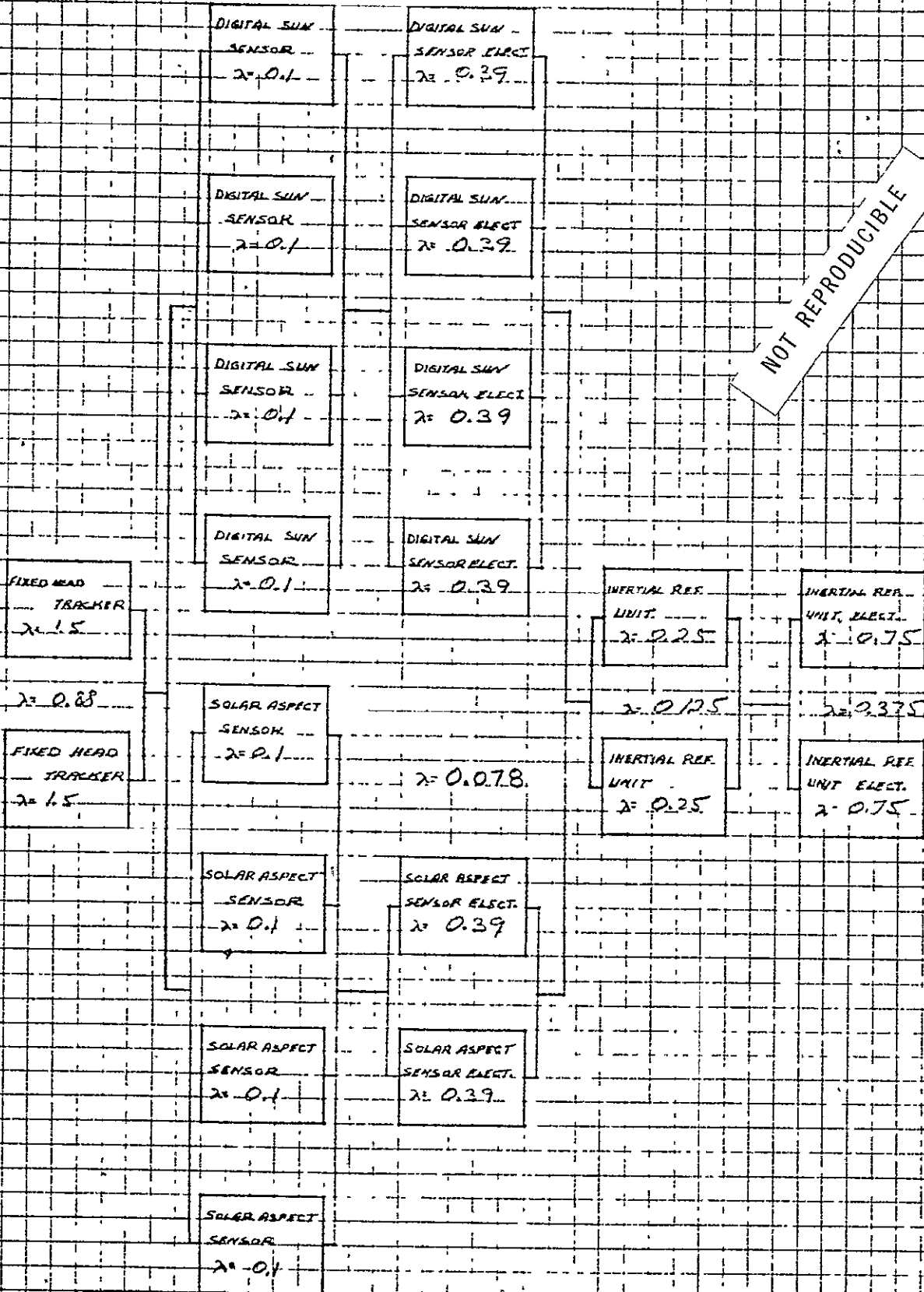
$$MTBF_{\text{LM}} = 32.147 \text{ HRS}$$

NOTE: ALL λ ARE IN FAILURES PER 10^6 HRS.

STABILIZATION & CONTROL

EQUIPMENT LEVEL AIRCRAFT

NOT REPRODUCIBLE



STABILIZATION CONTROL (CONTINUED)

EQUIPMENT LEVEL AIRCRAFT

MAG. TORQUE
BAR
 $\lambda = 0.0025$

MULTIPLIER
 $\lambda = 0.2$

MAG. TORQUE
BAR
 $\lambda = 0.0025$

MAGNETOMETER
 $\lambda = 0.001$

MAGNETOMETER
ELECTRONICS
 $\lambda = 0.39$

INVERTER
 $\lambda = 1.0$

MULTIPLIER
 $\lambda = 0.2$

$\lambda = 0.0002$

MAGNETOMETER
 $\lambda = 0.001$

MAGNETOMETER
ELECTRONICS
 $\lambda = 0.39$

INVERTER
 $\lambda = 1.0$

MULTIPLIER
 $\lambda = 0.2$

MAG. TORQUE
BAR
 $\lambda = 0.0025$

$\lambda = 0.1$

MULTIPLIER
 $\lambda = 0.2$

REMOTE
DECODER
 $\lambda = 1.0$

OFFSET
TRACKER
 $\lambda = 0.02$

WHEELS
 $\lambda = 0.006$

WHEELS
 $\lambda = 0.006$

WHEELS
 $\lambda = 0.006$

$\lambda = 2.0$

$\lambda = 0.01$

$\lambda = 0.003$

$\lambda = 0.003$

$\lambda = 0.003$

REMOTE
DECODER
 $\lambda = 1.0$

OFFSET
TRACKER
 $\lambda = 0.02$

WHEELS
 $\lambda = 0.006$

WHEELS
 $\lambda = 0.006$

WHEELS
 $\lambda = 0.006$

FINE WHEEL
F. CONTROL
 $\lambda = 0.033$

FINE WHEELS
F. CONTROL
 $\lambda = 0.033$

WIRING
HARNESS
 $\lambda = 0.1$

$\lambda = 0.01$

FINE WHEEL
F. CONTROL
 $\lambda = 0.033$

$\lambda_{\text{stab f. contr.}} = 4.386$ FAILURES PER 10³ HRS

MTBF ETC = 228 HRS

STABILIZATION & CONTROL

EQUIPMENT LEVEL L. M.

NOT REPRODUCIBLE

FIXED HEAD
TRACKER
λ 1.28

λ 0.64

FIXED HEAD
TRACKER
λ 1.28

DIGITAL SUN
SENSOR
λ 0.1

DIGITAL SUN
SENSOR ELECT
λ 9.0

DIGITAL SUN
SENSOR
λ 0.1

DIGITAL SUN
SENSOR ELECT
λ 9.0

DIGITAL SUN
SENSOR
λ 0.1

DIGITAL SUN
SENSOR ELECT
λ 9.0

DIGITAL SUN
SENSOR
λ 0.1

DIGITAL SUN
SENSOR ELECT
λ 9.0

INERTIAL REF.
UNIT
λ 13.0

INERTIAL REF.
UNIT ELECT.
λ 13

λ 6.5

λ 0.65

INERTIAL REF.
UNIT
λ 13.0

INERTIAL REF.
UNIT ELECT.
λ 13

SOLAR ASPECT
SENSOR
λ 6.0

λ 1.314

SOLAR ASPECT
SENSOR
λ 6.0

SOLAR ASPECT
SENSOR ELECT
λ 18.0

SOLAR ASPECT
SENSOR
λ 6.0

SOLAR ASPECT
SENSOR ELECT
λ 18.0

SOLAR ASPECT
SENSOR
λ 6.0

ALL λ IN FAILURES PER 10⁴ HRS

94

STABILIZATION & CONTROL (CONTINUED)

EQUIPMENT LEVEL

LM

MAG. TORQUE
BAR
 $\lambda = 9.0$

MAG. TORQUE
BAR
 $\lambda = 9.0$

MAG. TORQUE
BAR
 $\lambda = 9.0$

MAGNETOMETER
 $\lambda = 0.07$

$\lambda = 0.035$

MAGNETOMETER
 $\lambda = 0.07$

MAGNETOMETER
ELECTRONICS
 $\lambda = 4.8$

$\lambda = 2.4$

MAGNET FILTER
ELECTRONICS
 $\lambda = 4.8$

INVERTER
 $\lambda = 7.0$

$\lambda = 3.5$

INVERTER
 $\lambda = 7.0$

MULTIPLEXER
 $\lambda = 1.0$

MULTIPLEXER
 $\lambda = 1.0$

MULTIPLEXER
 $\lambda = 1.0$

$\lambda = 0.25$

MULTIPLEXER
 $\lambda = 1.0$

NOT REPRODUCIBLE

REMOTE
DECODER
 $\lambda = 3.75$

$\lambda = 1.875$

REMOTE
DECODER
 $\lambda = 3.75$

OFFSET
TRACKER
 $\lambda = 1.28$

$\lambda = 0.64$

OFFSET
TRACKER
 $\lambda = 1.28$

WHEELS
 $\lambda = 1.5$

$\lambda = 0.75$

WHEELS
 $\lambda = 1.5$

WHEELS
 $\lambda = 1.5$

$\lambda = 0.75$

WHEELS
 $\lambda = 1.5$

WHEELS
 $\lambda = 1.5$

$\lambda = 0.75$

WHEELS
 $\lambda = 1.5$

FINE WHEEL &
JST CONTROLLER
 $\lambda = 8.4$

FINE WHEEL &
JST CONTROLLER
 $\lambda = 8.4$

$\lambda = 2.8$

FINE WHEEL &
JST CONTROLLER
 $\lambda = 8.4$

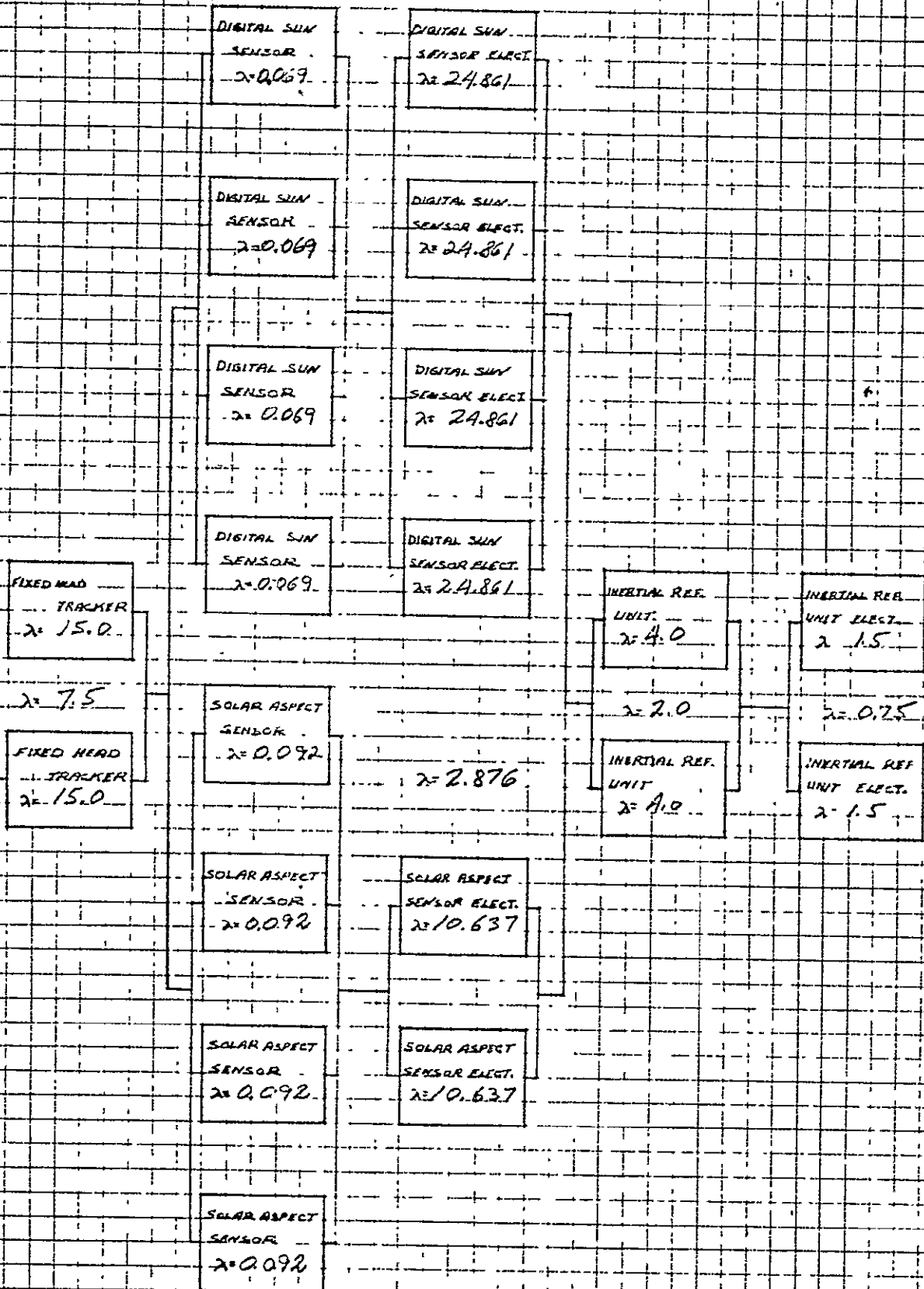
WIRING
HARNESS
 $\lambda = 0.1$

$\lambda_{STAB \& CONT} = 25,954 \text{ HOURS } \approx 3 \text{ YEARS}$

MTBF $\lambda_{FC} = 38,529$

STABILIZATION & CONTROL

EQUIPMENT LEVEL 0.0.0



ALL λ IN FAILURES PER 10⁶ HRS

STABILIZATION & CONTROL (CONTINUED)

EQUIPMENT LEVEL: 0610

MAG. TORQUE
BAR
 $\lambda = 0.05$

MULTIPLIER
 $\lambda = 2.0$

MAGNETOMETER
 $\lambda = 1.0$

MAGNETOMETER
ELECTRONICS
 $\lambda = 0.5$

INVERTER
 $\lambda = 1.0$

MULTIPLIER
 $\lambda = 2.0$

MAG. TORQUE
BAR
 $\lambda = 0.05$

$\lambda = 0.5$

$\lambda = 0.25$

$\lambda = 0.5$

MULTIPLIER
 $\lambda = 2.0$

$\lambda = 0.017$

MAGNETOMETER
 $\lambda = 1.0$

MAGNET-FILTER
ELECTRONICS
 $\lambda = 0.5$

INVERTER
 $\lambda = 1.0$

$\lambda = 0.5$

MAG. TORQUE
BAR
 $\lambda = 0.05$

MULTIPLIER
 $\lambda = 2.0$

REMOTE
DECODER
 $\lambda = 2.0$

CRUISE
TRACKER
 $\lambda = 1.28$

WHEELS
 $\lambda = 0.586$

WHEELS
 $\lambda = 0.586$

WHEELS
 $\lambda = 0.586$

$\lambda = 1.0$

$\lambda = 0.64$

$\lambda = 0.293$

$\lambda = 0.293$

$\lambda = 0.293$

REMOTE
INVERTER
 $\lambda = 2.0$

DEFSET
TRACKER
 $\lambda = 1.28$

WHEELS
 $\lambda = 0.586$

WHEELS
 $\lambda = 0.586$

WHEELS
 $\lambda = 0.586$

FINE WHEEL &
MT. CONTROLLER
 $\lambda = 33.377$

FINE WHEELS MT.
CONTROLLER
 $\lambda = 33.377$

WIRING
HARNESS
 $\lambda = 0.1$

$\lambda = 11.25$

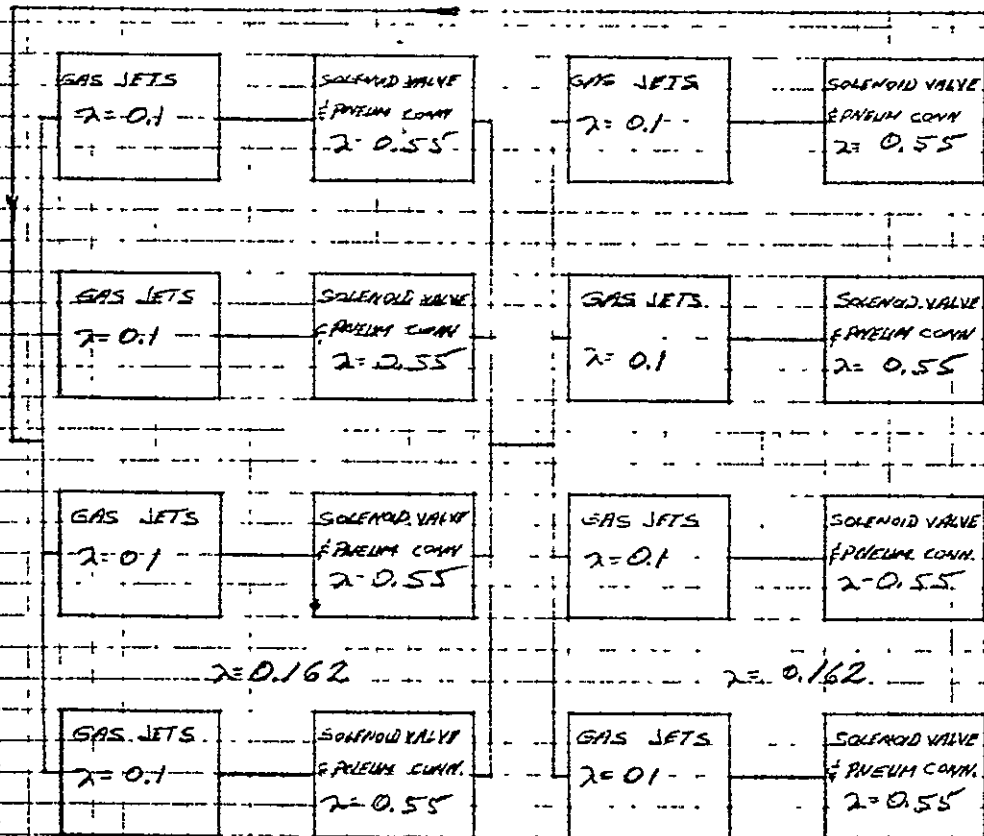
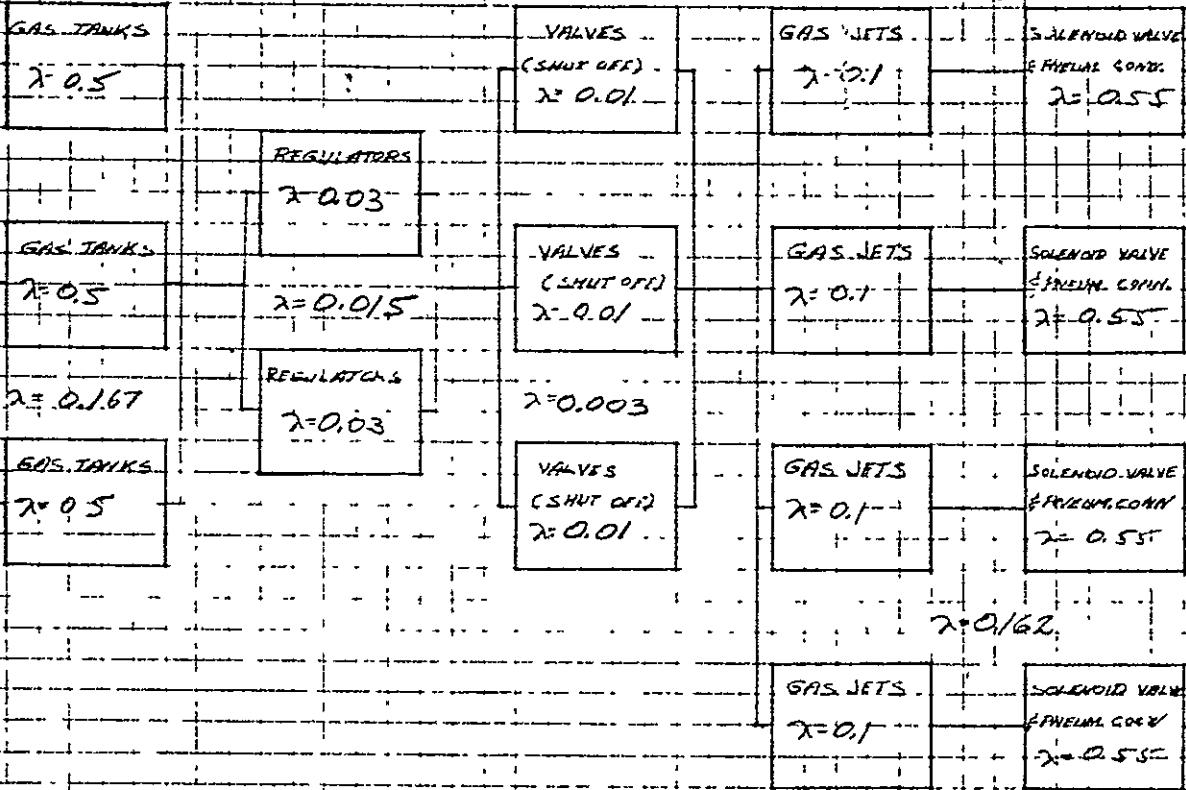
FINE WHEELS
MT. CONTROLLER
 $\lambda = 33.377$

λ STAB. & CONT. = 28.638 FAILURES PER
10⁶ HRS
MTBF 124C = 34,918 HRS

NOT REPRODUCIBLE

PNEUMATICS

EQUIPMENT LEVEL 0 AD



OVER

GAS JETS
 $\lambda = 0.1$

SOLENOID VALVE
PNEUM. COIL
 $\lambda = 0.55$

GAS JETS
 $\lambda = 0.1$

SOLENOID VALVE
PNEUM. COIL
 $\lambda = 0.55$

GAS JETS
 $\lambda = 0.1$

SOLENOID VALVE
PNEUM. COIL
 $\lambda = 0.55$

GAS JETS
 $\lambda = 0.1$

SOLENOID VALVE
PNEUM. COIL
 $\lambda = 0.55$

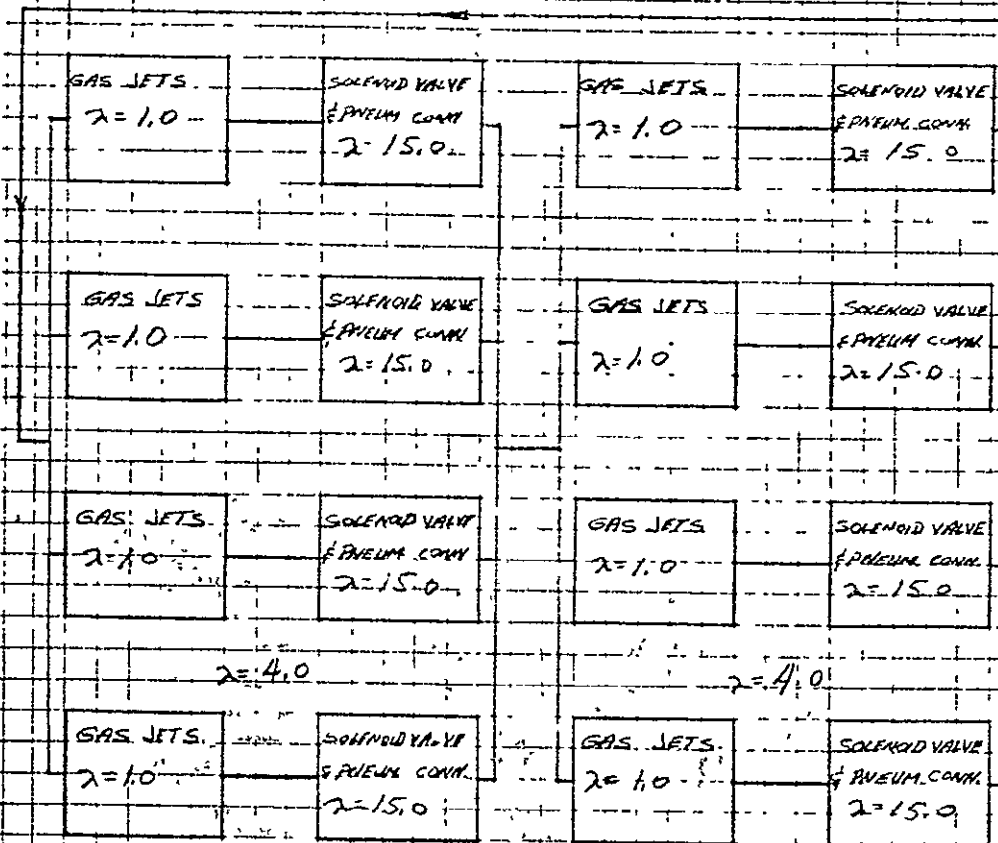
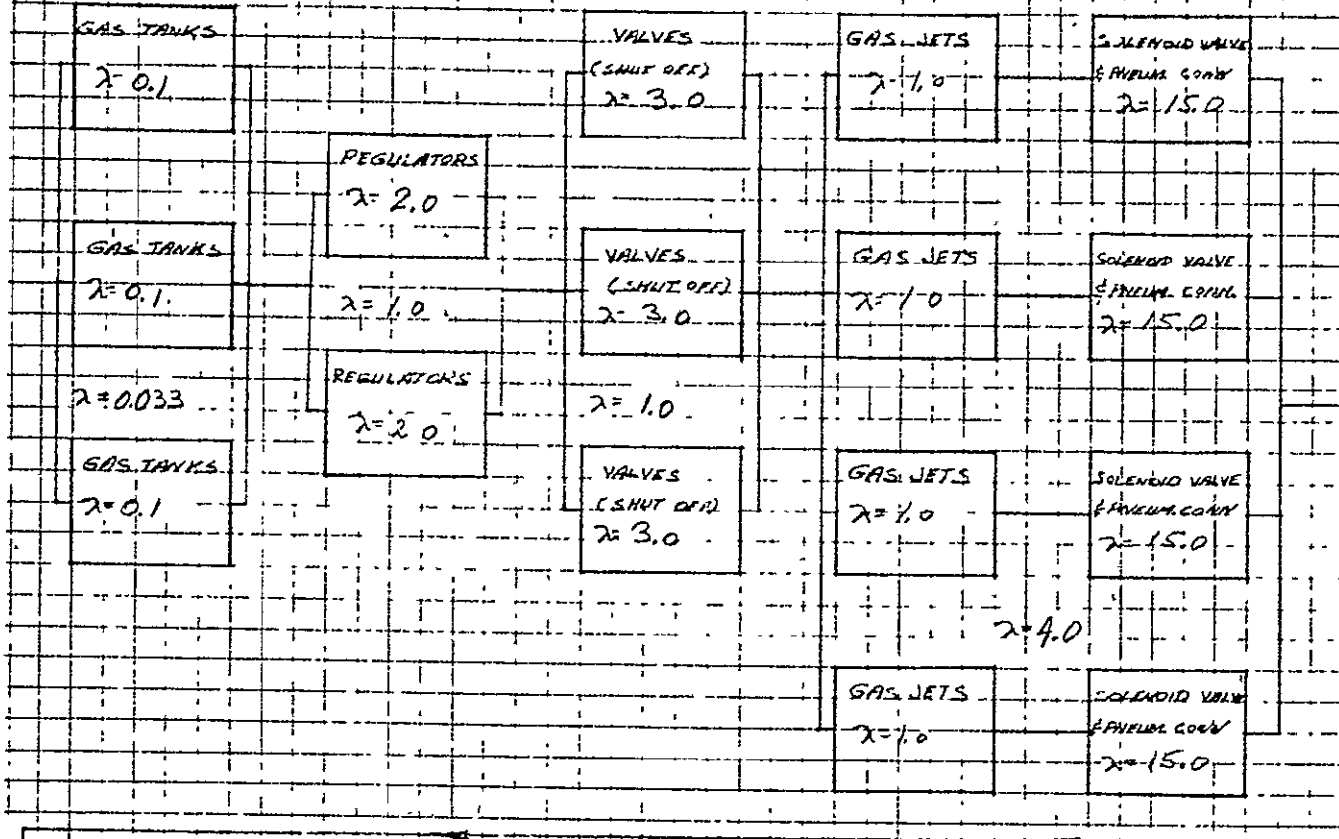
$\lambda = 0.162$

PIPES
 $\lambda = 0.1$

WIRING
HARNESS
 $\lambda = 0.1$

$\lambda_{PNEUMATICS} = 1.033 \text{ FAILURES PER 100 HRS.}$

MTBF PNEUMATICS: 968,254 HRS.

ALL ARE UN. FAILURES PER 10^{10} HRS.

PNEUMATICS (CONTINUED)

EQUIPMENT LEVEL

NOT REPRODUCIBLE

GAS JETS
 $\lambda = 1.0$

SOLENOID VALVE
& PNEUM. CONN
 $\lambda = 15.0$

GAS JETS
 $\lambda = 1.0$

SOLENOID VALVE
& PNEUM. CONN
 $\lambda = 15.0$

GAS JETS
 $\lambda = 1.0$

SOLENOID VALVE
& PNEUM. CONN
 $\lambda = 15.0$

$\lambda = 4.0$

GAS JETS
 $\lambda = 1.0$

SOLENOID VALVE
& PNEUM. CONN
 $\lambda = 15.0$

PIPES
 $\lambda = 0.1$

WIRING
HARNESSES
 $\lambda = 0.1$

$\lambda_{\text{PNEUMATICS}} = 18,233 \text{ FAILURES PER } 10^6 \text{ HRS}$

MTBF PNEUMATICS = 54,845

103

PERCOM PROGRAM

PROGRAM NO. 39

SHUTTLE SCHEDULE DELAY... 1.5
 TOTAL SYSTEM MTF... 15.0
 VAR. SUBSYSTEM SLOPE... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED NON-RECURRING RECURRING OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1162441.	30886976.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721493.
6	ELECTRIC POWER	551829.	13927137.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	3206258.	20816604.
9	PNEUMATICS	23185.	4500433.
10	TEST & SUPPORT EQUIPMENT	4660540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448604.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	108000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	85790432.	134772000.	9000000.
	G & A	11066961.	17385568.	1160999.
	SUBTOTAL	96857392.	152157568.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	111054400.	347021056.	10160999.
	*NO G & A CHARGE			

TOTAL

468236288.

COST OF ADD'L SHUTTLE REPAIR FLTS

20909088.

GRAND TOTAL

489145344.

NO. OF FAILURES... 10.18

UPTIME (YEARS)... 12.73

UPTIME RATIO... 0.85

PERCOM PROGRAM

PROGRAM NO.40

SHUTTLE SCHEDULE DELAY.. 2.0
TOTAL SYSTEM MTTF..... 15.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30640216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1162441.	30886976.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS.	3520000.	2721443.
6	ELECTRIC POWER	551829.	13927137.
7	* PRIMARY OPTICS	3300000.	8000078.
8	COMM. & DATA HANDLING	3206258.	20816608.
9	PNEUMATICS	23185.	4500433.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448598.
13	RELIABILITY	111600.	133900.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60900000.

ORBITAL OPERATIONS

G & A CHARGEABLE	85790432.	134772000.	
G & A	11066961.	17385568.	1160999.
SUBTOTAL	96857392.	152157568.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	111054400.	347021056.	10160999.

*NO G & A CHARGE

TOTAL

468236288.

COST OF ADD'L SHUTTLE REPAIR FLTS

19411760.

GRAND TOTAL

487648000.

NO. OF FAILURES.... 9.88

UPTIME (YEARS)..... 12.35

UPTIME RATIO..... 0.82

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO. 41

SHUTTLE SCHEDULE DELAY, 2.5

TOTAL SYSTEM MTF, 15.0

VAR. SUBSYSTEM SLOPE, 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30549216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1162441.	30886976.
4	THERMAL	2120000.	2010971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	551829.	13927137.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	3206258.	20816608.
9	PNEUMATICS	23185.	4500433.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	113800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1097000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A, B, C	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G, S, F, C, & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

90000000.

G & A CHARGEABLE	85790432.	134772000.
G & A	11066961.	17385568.
SUBTOTAL	96857392.	152157568.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	111054400.	347021056.

*NO G & A CHARGE

10160999.

TOTAL

468236288.

COST OF ADD'L SHUTTLE REPAIR FLTS

17999984.

GRAND TOTAL

486236160.

NO. OF FAILURES, 9.60

UPTIME (YFAPS), 12.00

UPTIME RATIO, 0.80

PERCOM PROGRAM

PROGRAM NO.42

SHUTTLE SCHEDULE DELAY.. 3.0
TOTAL SYSTEM MTF..... 15.0
VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINCO PROGRAM
(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30640216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1162441.	30886976.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	551829.	13927137.
7	* PRIMARY OPTICS	3300000.	8000478.
8	COMM. & DATA HANDLING	3206258.	20816608.
9	PNEUMATICS	23185.	4500433.
10	TEST & SUPPORT EQUIPMENT	4660540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7110000.
12	SYSTEM INTEGRATION	944000.	2448678.
13	RELIABILITY	111600.	137400.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	85790432.	134772000.	9000000.
	G & A	11066961.	17385568.	1160999.
	SUBTOTAL	96857392.	152157568.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	111054400.	347021056.	10160999.
	*NO G & A CHARGE			

TOTAL

468236288.

COST OF ADD'L SHUTTLE REPAIR FLTS

16666665.

GRAND TOTAL

484902912.

NO. OF FAILURES.... 9.33

UPTIME (YEARS)..... 11.67

UPTIME RATIO..... 0.78

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.43

SHUTTLE SCHEDULE DELAY... 6.0
 TOTAL SYSTEM MTF..... 15.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

13 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1162441.	10886976.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	551829.	13927137.
7	* PRIMARY OPTICS	3100000.	8000878.
8	COMM. & DATA HANDLING	3206258.	20815608.
9	PNEUMATICS	23185.	4500433.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2531000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	502000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

NOT REPRODUCIBLE

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

90000000.

G & A CHARGEABLE	85790432.	134772000.
G & A	11066961.	17385568.
SUBTOTAL	96857392.	152157568.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	111054400.	347021056.
*NO G & A CHARGE		10160999.

TOTAL

468236288.

COST OF ADD'L SHUTTLE REPAIR FLTS

10000000.

GRAND TOTAL

478236160.

NO. OF FAILURES.... 8.00

UPTIME (YEARS)..... 10.00

UPTIME RATIO..... 0.67

PERCOM PROGRAM

PROGRAM NO.44

SHUTTLE SCHEDULE DELAY... 12.0
 TOTAL SYSTEM MTTF..... 15.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

	NON-RECURRING	RECURRING	OPERATIONS
1 STRUCTURE	20150000.	30649216.	
2 ENGINEERING	17500000.	2250126.	
3 STABILIZATION	1162441.	30886976.	
4 THERMAL	2120000.	2910971.	
5 S-C MECHANISMS	3520000.	2721481.	
6 ELECTRIC POWER	551829.	13927137.	
7 * PRIMARY OPTICS	3300000.	8000878.	
8 COMM. & DATA HANDLING	3206258.	20816608.	
9 PNEUMATICS	21185.	4500433.	
10 TEST & SUPPORT EQUIPMENT	4669540.	2070634.	
11 PROGRAM MANAGEMENT	2533000.	7119000.	
12 SYSTEM INTEGRATION	944000.	2448699.	
13 RELIABILITY	111600.	131000.	
14 QUALITY ACCEPTANCE	1445220.	5820000.	
15 TITAN INTERSTAGE	582000.	670000.	
16 * TITAN SHROUD	0.0	1000000.	
17 SHUTTLE INTERFACES	20910000.	1997000.	
18 TRAINERS & SIMULATORS	3110400.	100000.	
19 * EXPERIMENTS A & B	5000000.	39000000.	
20 GROUND STATION	3251000.	800000.	
21 * NEW COMPUTERS	4550000.	0.0	

LAUNCH OPERATIONS

	NON-RECURRING	RECURRING	OPERATIONS
22 * LV-TITAN	0.0	22500000.	
23 * LV-SHUTTLE	0.0	10000000.	
24 S-C SUPPORT	0.0	4950000.	
25 * FACILITIES	1347012.	362826.	
26 * SHUTTLE UPDATE FLIGHT	0.0	15000000.	
27 * EXPERIMENT UPDATE	0.0	39000000.	
28 * G.S.F.C. & OTHER	0.0	60000000.	

9000000.

29 ORBITAL OPERATIONS

	NON-RECURRING	RECURRING	OPERATIONS
G & A CHARGES	85790432.	134772000.	
G & A	11066961.	17385568.	1160999.
SUBTOTAL	96857392.	152157568.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	111054400.	347021056.	10160999.
*NO G & A CHARGE			

TOTAL

468236288.

0.0

COST OF ADD'L SHUTTLE REPAIR FLTS

468236288.

GRAND TOTAL

NO. OF FAILURES.... 6.22

UPTIME (YEARS).... 7.78

UPTIME RATIO..... 0.52

PERCON PROGRAM

PROGRAM NO. 45

SHUTTLE SCHEDULE DELAY... 24.0
 TOTAL SYSTEM MTTF..... 15.0
 VAR. SUBSYSTEM SLOPE... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1162441.	30496976.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721443.
6	ELECTRIC POWER	551829.	13927137.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	3206258.	20816608.
9	PNEUMATICS	23185.	4500413.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	113400.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	8000000.
21	* NEW COMPUTERS	4550000.	0.0

NOT REPRODUCIBLE

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

90000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	85790432.	134772000.
G & A	11066961.	17385568.
SUBTOTAL	96857392.	152157568.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	111054400.	347021056.
*NO G & A CHARGE		

468236298.

TOTAL

0.0

COST OF ADD'L SHUTTLE REPAIR FLTS

468236288.

GRAND TOTAL

NO. OF FAILURES.... 4.31

UPTIME (YEARS)..... 5.38

UPTIME RATIO..... 0.36

PERCOM PROGRAM

PROGRAM NO. 46

SHUTTLE SCHEDULE DELAY.. 0.5
 TOTAL SYSTEM MTTF..... 18.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	70649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1618100.	42994209.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	768118.	19386152.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	4463058.	28976384.
9	PNEUMATICS	32271.	6264530.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7112000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	113800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	87728288.	162262120.	90000000.
	G & A	11316944.	20931824.	1160999.
	SUBTOTAL	99045232.	183194144.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	113242240.	378057729.	10160999.

*NO G & A CHARGE

TOTAL

501460736.

COST OF ADD'L SHUTTLE REPAIR FLTS

15405402.

GRAND TOTAL

516866048.

NO. OF FAILURES.... 9.08

UPTIME (YEARS)..... 13.62

UPTIME RATIO..... 0.91

PERCOM PROGRAM

PROGRAM NO.47

SHUTTLE SCHEDULE DELAY... 1.0
 TOTAL SYSTEM MTF..... 18.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1618100.	42996209.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721487.
6	ELECTRIC POWER	768138.	19386352.
7	* PRIMARY OPTICS	3300000.	8000478.
8	COMM. & DATA HANDLING	4463058.	28276384.
9	PNEUMATICS	32273.	6261510.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449699.
13	RELIABILITY	111600.	131800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	30000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	162826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	30000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	87728288.	162262320.
G & A	11316944.	20971824.
SUBTOTAL	99045232.	183194144.
NOV-G & A SUBTOTAL	14197012.	194863680.
TOTAL	113242240.	378057728.
*NO G & A CHARGE		10160999.

TOTAL

501460736.

COST OF ADD'L SHUTTLE REPAIR FLTS

14210524.

GRAND TOTAL

515671040.

NO. OF FAILURES.... 8.84

UPTIME (YEARS)..... 13.26

UPTIME RATIO..... 0.88

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.48

SHUTTLE SCHEDULE DELAY.. 1.5
 TOTAL SYSTEM MTF..... 18.0
 VAR. SUBSYSTEM SLOPE..... 1.25

.....
 SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

	NON-RECURRING	RECURRING
1 STRUCTURE	20150000.	30649216.
2 ENGINEERING	17500000.	2250126.
3 STABILIZATION	1610100.	42094208.
4 THERMAL	2120000.	2910971.
5 S-C MECHANISMS	3520000.	2721481.
6 ELECTRIC POWER *	768138.	19386352.
7 * PRIMARY OPTICS	3300000.	8000078.
8 COMM. & DATA HANDLING	4463058.	28976484.
9 PNEUMATICS	32273.	6264510.
10 TEST & SUPPORT EQUIPMENT	4669540.	2070574.
11 PROGRAM MANAGEMENT	2533000.	7110000.
12 SYSTEM INTEGRATION	944000.	2440698.
13 RELIABILITY	111600.	133400.
14 QUALITY ACCEPTANCE	1445220.	5820000.
15 TITAN INTERSTAGE	582000.	670000.
16 * TITAN SHROUD	0.0	1000000.
17 SHUTTLE INTERFACES	20910000.	1997000.
18 TRAINERS & SIMULATORS	3110400.	1000000.
19 * EXPERIMENTS A & B	5000000.	39000000.
20 GROUND STATION	3251000.	8000000.
21 * NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

	NON-RECURRING	RECURRING
22 * LV-TITAN	0.0	22500000.
23 * LV-SHUTTLE	0.0	10000000.
24 S-C SUPPORT	0.0	4950000.
25 * FACILITIES	1347012.	362826.
26 * SHUTTLE UPDATE FLIGHT	0.0	15000000.
27 * EXPERIMENT UPDATE	0.0	39000000.
28 * G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

	NON-RECURRING	RECURRING	OPERATIONS
G & A CHARGEABLE	87728288.	162262320.	
G & A	11316944.	20931824.	1160999.
SUBTOTAL	99045232.	183194144.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	113242240.	378057728.	10160999.

*NO G & A CHARGE

TOTAL

501460736.

COST OF ADD'L SHUTTLE REPAIR FLTS

11076920.

GRAND TOTAL

514537472.

NO. OF FAILURES.... 8.62

UPTIME (YEARS).... 12.92

UPTIME RATIO..... 0.86

PERCOM PROGRAM

PROGRAM NO. 49

SHUTTLE SCHEDULE DELAY... 2.0

TOTAL SYSTEM MTTF..... 18.0

VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250125.
3	STABILIZATION	1618100.	42004208.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721443.
6	ELECTRIC POWER	768139.	19386352.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	4463058.	28776384.
9	PNEUMATICS	32273.	6264530.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1907000.
18	TRAINERS & SIMULATORS	3110400.	1000000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	8000000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	762826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	87728288.	162262320.	9000000.
	G & A	11316944.	20931824.	1160999.
	SUBTOTAL	99045232.	183194144.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	113242240.	378057728.	10160999.
	*NO G & A CHARGE			

TOTAL

501460736.

11999998.

513460480.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 8.40

UPTIME (YEARS)..... 12.60

UPTIME RATIO..... 0.84

PERCOM PROGRAM

PROGRAM NO.50

SHUTTLE SCHEDULE DELAY.. 2.5
 TOTAL SYSTEM MTF..... 18.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	10649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1618100.	42994209.
4	THERMAL	2120000.	2910071.
5	S-C MECHANISMS	3520000.	2721487.
6	ELECTRIC POWER	768138.	19386352.
7	* PRIMARY OPTICS	3100000.	8000478.
8	COMM. & DATA HANDLING	4463058.	28976194.
9	PNEUMATICS	32273.	6264530.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449698.
13	RELIABILITY	111600.	131800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	30000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	87728288.	162262320.
G & A	11316944.	20931924.
SUBTOTAL	99045232.	183194144.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	113242240.	378057728.
*NO G & A CHARGE		

TOTAL

501460736.

COST OF ADD'L SHUTTLE REPAIR FLTS

10975608.

GRAND TOTAL

512436224.

NO. OF FAILURES.... 8.20

UPTIME (YEARS)..... 12.29

UPTIME RATIO..... 0.82

PERCOM PROGRAM

PROGRAM NO. 51

SHUTTLE SCHEDULE DELAY... 3.0
 TOTAL SYSTEM MTTF..... 18.0
 VAP. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(1 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1618100.	42994208.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	768138.	19186152.
7	* PRIMARY OPTICS	1300000.	8000878.
8	COMM. & DATA HANDLING	4467058.	28976344.
9	PNEUMATICS	32271.	6264510.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070414.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449699.
13	RELIABILITY	111600.	1133000.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	19000000.
28	* G.S.P.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	87728288.	162262320.	9000000.
	G & A	11316944.	20931824.	1160999.
	SUBTOTAL	99045232.	183194144.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	113242240.	378057728.	10160999.
	*NO G & A CHARGE			

TOTAL

501460736.

COST OF ADD'L SHUTTLE REPAIR FLTS

10000000.

GRAND TOTAL

511460608.

NO. OF FAILURES.... 8.00

UPTIME (YEARS)..... 12.00

UPTIME RATIO..... 0.80

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.52

SHUTTLE SCHEDULE DELAY... 6.0
 TOTAL SYSTEM MTF..... 19.0
 VAP. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30640216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1610100.	42994208.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721401.
6	ELECTRIC POWER	760130.	19186152.
7	* PRIMARY OPTICS	3100000.	8000978.
8	COMM. & DATA HANDLING	4461058.	28976184.
9	PNEUMATICS	32273.	6264510.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2531000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

9000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	87728288.	162262320.
G & A	11716944.	20931024.
SUBTOTAL	99045232.	183194144.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	113242240.	378057720.
*NO G & A CHARGE		

10160999.

TOTAL

501460736.

5000000.

506460672.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 7.00

UPTIME (YEARS)..... 10.50

UPTIME RATIO..... 0.70

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO. 53

SHUTTLE SCHEDULE DELAY: 12.0

TOTAL SYSTEM MTTF: 10.0

VAR. SUBSYSTEM SLOPE: 1.25

SHUTTLE-MAINTAINED PROGRAM
(3 SPECIALTIES)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1618100.	42994208.
4	THERMAL	2120000.	2910971.
5	S/C MECHANISMS	3520000.	6272483.
6	ELECTRIC POWER	768130.	19386352.
7	PRIMARY OPTICS	3300000.	8090878.
8	COMM. & DATA HANDLING	4463058.	28974384.
9	PNEUMATICS	32273.	6244530.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	87728288.	162262320.	9000000.
	G & A	11316944.	20931824.	1160999.
	SUBTOTAL	99045232.	183194144.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	113242240.	378057728.	10160999.
	*NO G & A CHARGE			

TOTAL

501460736.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

501460736.

NO. OF FAILURES: 5.60

UPTIME (YEARS): 8.40

UPTIME RATIO: 0.55

PERCOM PROGRAM

PROGRAM NO. 54

SHUTTLE SCHEDULE DELAY.. 24.0
 TOTAL SYSTEM MTTF..... 18.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	1618100.	42994208.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	768138.	1938352.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	4463058.	28076394.
9	PNEUMATICS	32273.	6264530.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133900.
14	QUALITY ACCEPTANCE	1445220.	5420000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4920000.
25	* FACILITIES	1347012.	362836.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

9000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	87728288.	162262320.
G & A	11316944.	20931824.
SUBTOTAL	99045232.	183194144.
NON-G & A SUBTOTAL	14197012.	174863680.
TOTAL	113242240.	378057728.
*NO G & A CHARGE		

10160999.

TOTAL

501460736.

0.0

COST OF ADD'L SHUTTLE REPAIR FLTS

501460736.

GRAND TOTAL

NO. OF FAILURES.... 4.00

UPTIME (YEARS)..... 6.00

UPTIME RATIO..... 0.40

PERCOM PROGRAM

PROGRAM NO.55

SHUTTLE SCHEDULE DELAY., 0.5
 TOTAL SYSTEM MTTF..... 21.0
 VAR. SUBSYSTEM SLOPE., 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	70649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2130631.	56612560.
4	THERMAL	2120000.	2910071.
5	S-C MECHANISMS	7520000.	2721483.
6	ELECTRIC POWER	1011444.	25526944.
7	* PRIMARY OPTICS	7300000.	8000078.
8	COMM. & DATA HANDLING	5876740.	38154704.
9	PNEUMATICS	42400.	8240030.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448690.
13	RELIABILITY	111600.	133000.
14	QUALITY ACCEPTANCE	1445220.	5920000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	30000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	225000000.
23	* LV-SHUTTLE	0.0	100000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	30000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	89908016.	103183872.	90000000.
	G & A	11598129.	24920704.	11609999.
	SUBTOTAL	101506144.	218104576.	
	NON-G & A SUBTOTAL	14197012.	174863680.	
	TOTAL	115703152.	412968192.	10160999.
	*NO G & A CHARGE			

TOTAL

538832128.

COST OF ADD'L SHUTTLE REPAIR FLTS

9069766.

GRAND TOTAL

547901696.

NO. OF FAILURES.... 7.81

UPTIME (YEARS)..... 13.67

UPTIME RATIO..... 0.91

NOT REPRODUCIBLE

1264

PERCOM PROGRAM

PROGRAM NO.56

SHUTTLE SCHEDULE DELAY... 1.0

TOTAL SYSTEM MTF..... 21.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30647716.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2130631.	56612560.
4	THERMAL	2120000.	2910071.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	1011444.	25526944.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	5876740.	10154704.
9	PNEUMATICS	42495.	8248810.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2513000.	7112000.
12	SYSTEM INTEGRATION	944000.	2448690.
13	RELIABILITY	111600.	111900.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	19000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	89908016.	193183872.	9000000.
	G & A	11590129.	24920704.	1160999.
	SUBTOTAL	101506144.	218104576.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	115703152.	412968192.	10160999.

*NO G & A CHARGE

TOTAL

538832128.

COST OF ADD'L SHUTTLE REPAIR FLTS

8181815.

GRAND TOTAL

547013988.

NO. OF FAILURES.... 7.64

UPTIME (YEARS)..... 13.36

UPTIME RATIO..... 0.89

PERCOM PROGRAM

PROGRAM NO.57

SHUTTLE SCHEDULE DELAY., 1.5
 TOTAL SYSTEM MTTF..... 21.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(1 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2130631.	56612560.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	1011444.	25526944.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	5876740.	38154704.
9	PNEUMATICS	42495.	8249830.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2440698.
13	RELIABILITY	111600.	111800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100090.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

NOT REPRODUCIBLE

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	89908016.	193181872.	9000000.
	G & A	11598129.	24920704.	1160999.
	SUBTOTAL	101506144.	218104576.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	115703152.	412968192.	10160999.
	*NO G & A CHARGE			

TOTAL

538832128.

COST OF ADD'L SHUTTLE REPAIR FLTS

7333331.

GRAND TOTAL

546165248.

NO. OF FAILURES.... 7.47

UPTIME (YEARS)..... 13.07

UPTIME RATIO..... 0.87

PERCOM PROGRAM

PROGRAM NO. 58

SHUTTLE SCHEDULE DELAY... 2.0

TOTAL SYSTEM MTTF..... 21.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2130631.	56612560.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	1011444.	25526944.
7	* PRIMARY OPTICS	1100000.	8000978.
8	COMM. & DATA HANDLING	5876740.	38154704.
9	PNEUMATICS	42495.	8248810.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070534.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111500.	113900.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39080000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	89908016.	193187872.
G & A	11598129.	24920704.
SUBTOTAL	101506144.	218104576.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	115703152.	412968192.
*NO G & A CHARGE		10160999.

TOTAL

538832128.

COST OF ADD'L SHUTTLE REPAIR FLTS

6521735.

GRAND TOTAL

545353728.

NO. OF FAILURES.... 7.30

UPTIME (YEARS).... 12.78

UPTIME RATIO..... 0.85

PERCOM PROGRAM

PROGRAM NO. 59

SHUTTLE SCHEDULE DELAY... 2.5
 TOTAL SYSTEM MTTF..... 21.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2130631.	56612560.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	1011444.	25526944.
7	* PRIMARY OPTICS	3100000.	8000078.
8	COMM. & DATA HANDLING	5976740.	38154704.
9	PNEUMATICS	42495.	8248810.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2531000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448608.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	89908016.	193183872.	9000000.
	G & A	11598129.	24920704.	1160999.
	SUBTOTAL	101506144.	218104576.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	115703152.	412968192.	10160999.
	*NO G & A CHARGE			

TOTAL

538832128.

COST OF ADD'L SHUTTLE REPAIR FLTS

5744676.

GRAND TOTAL

544576768.

NO. OF FAILURES..... 7.15

UPTIME (YEARS)..... 12.51

UPTIME RATIO..... 0.83

PERCOM PROGRAM

PROGRAM NO.60

SHUTTLE SCHEDULE DELAY... 3.0
 TOTAL SYSTEM MTF..... 21.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2130631.	56612560.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	1011444.	25926944.
7	* PRIMARY OPTICS	3300000.	8000378.
8	COMM. & DATA HANDLING	5976740.	38154704.
9	PNEUMATICS	42405.	8248810.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	113000.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	30000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	89908016.	193183872.	9000000.
	G & A	11598129.	24920704.	1160999.
	SUBTOTAL	101506144.	218104576.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	115703152.	412968192.	10160999.

*NO G & A CHARGE

TOTAL

538832128.

COST OF ADD'L SHUTTLE REPAIR FLTS

5000000.

GRAND TOTAL

543832064.

NO. OF FAILURES.... 7.00

UPTIME (YEARS)..... 12.25

UPTIME RATIO..... 0.82

NOT REPRODUCIBLE

PERCOM PROGRAM 2

PROGRAM NO.61

SHUTTLE SCHEDULE DELAY... 6.0
 TOTAL SYSTEM MTF..... 21.0
 VAR. SUBSYSTEM SLOPE... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2130671.	56612560.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721493.
6	ELECTRIC POWER	1011444.	25526944.
7	* PRIMARY OPTICS	3700000.	9000078.
8	COMM. & DATA HANDLING	5876740.	39154704.
9	PNEUMATICS	42405.	8249030.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	111800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1747012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	30000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	89908016.	193183872.	9000000.
	G & A	11598129.	24920704.	1160999.
	SUBTOTAL	101506144.	218104576.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	115703152.	412968192.	10160999.
	*ND G & A CHARGE			

TOTAL

538832128.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

538832128.

NO. OF FAILURES.... 6.22

UPTIME (YFAS)..... 10.89

UPTIME RATIO..... 0.73

PERCON PROGRAM

PROGRAM NO.62

SHUTTLE SCHEDULE DELAY.. 12.0
TOTAL SYSTEM MTF..... 21.0
VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

		NON-RECURRING	RECURRING
1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2130631.	56612560.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	1011444.	25526944.
7	* PRIMARY OPTICS	3100000.	8000978.
8	COMM. & DATA HANDLING	5876740.	38154704.
9	PNEUMATICS	42495.	8248810.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362926.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

G & A CHARGEABLE	89908016.	193183872.
G & A	11598129.	24920704.
SUBTOTAL	101506144.	218104576.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	115703152.	412968192.
*NO G & A CHARGE		

TOTAL

538832128.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

538832128.

NO. OF FAILURES.... 5.09

UPTIME (YEARS)..... 8.91

UPTIME RATIO..... 0.59

PERCOM PROGRAM

PROGRAM NO.64

SHUTTLE SCHEDULE DELAY... 0.5
TOTAL SYSTEM MTF..... 24.0
VAR. SUBSYSTEM SLOPF.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2694125.	71585056.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	1278944.	32270160.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	7431007.	48245776.
9	PNEUMATICS	53735.	10430453.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111500.	113800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	679000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	34000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	92304512.	227180288.	9000000.
G & A	11907277.	29306240.	1160999.
SUBTOTAL	104211776.	256486528.	
NON-G & A SUBTOTAL	14197012.	174863680.	
TOTAL	118408788.	451350016.	10160999.
*NO G & A CHARGE			

TOTAL

579919616.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

579919616.

NO. OF FAILURES..... 6.86

UPTIME (YEARS)..... 13.71

UPTIME RATIO..... 0.91

NOT REPRODUCIBLE

PERCON PROGRAM

PROGRAM NO.63

SHUTTLE SCHEDULE DELAY.. 24.0
 TOTAL SYSTEM MTTF..... 21.0
 VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2130671.	56612560.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	1011444.	25526244.
7	* PRIMARY OPTICS	3100000.	8000978.
8	COMM. & DATA HANDLING	5876740.	36154704.
9	PNEUMATICS	42495.	8249830.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	111800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	89908016.	193183872.	9000000.
	G & A	11598129.	24920704.	1160999.
	SUBTOTAL	101506144.	218104576.	
	NON-G & A SUBTOTAL	14197012.	194867680.	
	TOTAL	115703152.	412968192.	10160999.
	*NO G & A CHARGE			

TOTAL

538832128.

0.0

COST OF ADD'L SHUTTLE REPAIR FLTS

538832128.

GRAND TOTAL

NO. OF FAILURES.... 3.73

UPTIME (YEARS)..... 6.53

UPTIME RATIO..... 0.44

PERCOM PROGRAM

PROGRAM NO.65

SHUTTLE SCHEDULE DELAY, 1.0
 TOTAL SYSTEM MTF..... 24.0
 VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2694125.	71585056.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	1278944.	32278160.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	7431007.	48245776.
9	PNEUMATICS	53735.	10430451.
10	TEST & SUPPORT EQUIPMENT	4669540.	2078634.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	114900.
14	QUALITY ACCEPTANCE	1445220.	5420000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	19000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	92304512.	227180288.	
G & A	11907277.	29306240.	1160999.
SUBTOTAL	104211776.	256486528.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	118408788.	451350016.	10160999.
*NO G & A CHARGE			

TOTAL

579919616.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

579919616.

NO. OF FAILURES.... 6.72

UPTIME (YEARS).... 13.44

UPTIME RATIO..... 0.90

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.66

SHUTTLE SCHEDULE DELAY.. 1.5

TOTAL SYSTEM MTTF..... 24.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2694125.	71585056.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	1278944.	32278160.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	7411007.	48245776.
9	PNEUMATICS	53735.	10410451.
10	TEST & SUPPORT EQUIPMENT	4659540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	131900.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	2091000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3291000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	* S-C SUPPORT	0.0	4050000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29. ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	92304512.	227180289.
G & A	11907277.	29306240.
SUBTOTAL	104211776.	256486528.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	118408788.	451350016.
*NO G & A CHARGE		10160999.

TOTAL

579919616.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

579919616.

NO. OF FAILURES.... 6.59

UPTIME (YEARS)..... 13.18

UPTIME RATIO..... 0.88

PERCOM PROGRAM

PROGRAM NO.67

SHUTTLE SCHEDULE DELAY... 2.0
 TOTAL SYSTEM MTTF..... 24.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2694125.	71585056.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	1278944.	32278160.
7	* PRIMARY OPTICS	3100000.	8000870.
8	COMM. & DATA HANDLING	7431007.	48245776.
9	PNEUMATICS	53735.	10430451.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449699.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	92304512.	227180288.
G & A	11907277.	29106240.
SUBTOTAL	104211776.	256486528.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	118408784.	451350016.

*NO G & A CHARGE

TOTAL

579919616.

0.0

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

579919616.

NO. OF FAILURES.... 6.46

UPTIME (YEARS).... 12.92

UPTIME RATIO..... 0.86

PERCOM PROGRAM

PROGRAM NO.68

SHUTTLE SCHEDULE DFLAY.. 2.5
 TOTAL SYSTEM MTF..... 24.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30640216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2694125.	71505056.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721493.
6	ELECTRIC POWER	1278944.	32270160.
7 *	PRIMARY OPTICS	3300000.	8000078.
8	COMM. & DATA HANDLING	7431007.	48245775.
9	PNEUMATICS	53715.	10410453.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2440699.
13	RELIABILITY	111600.	131800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16 *	TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19 *	EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21 *	NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22 *	LV-TITAN	0.0	22500000.
23 *	LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25 *	FACILITIES	1347012.	362826.
26 *	SHUTTLE UPDATE FLIGHT	0.0	15000000.
27 *	EXPERIMENT UPDATE	0.0	39000000.
28 *	G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	92304512.	227180288.	
G & A	11907277.	29306240.	1160999.
SUBTOTAL	104211776.	256486528.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	118408788.	451350016.	10160999.
*NO G & A CHARGE			

TOTAL

579919616.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

579919616.

NO. OF FAILURES.... 6.34

UPTIME (YEARS)..... 12.68

UPTIME RATIO..... 0.85

PERCOM PROGRAM

PROGRAM NO.69

SHUTTLE SCHEDULE DELAY... 3.0
TOTAL SYSTEM MTF..... 24.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30640216.
2	ENGINEERING	17500000.	2750126.
3	STABILIZATION	2694175.	71585056.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	1278944.	32278160.
7	* PRIMARY OPTICS	3100000.	8000479.
8	COMM. & DATA HANDLING	7431007.	48245776.
9	PNEUMATICS	53735.	10430453.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070534.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5020000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	225000000.
23	* LV-SHUTTLE	0.0	100000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362426.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	92304512.	227180288.	9000000.
G & A	11907277.	29306240.	1160999.
SUBTOTAL	104211776.	256486528.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	118408788.	451350016.	10160999.
*NO G & A CHARGE			

TOTAL

579919616.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

0.0

579919616.

NO. OF FAILURES.... 5.22

UPTIME (YEARS).... 12.44

UPTIME RATIO..... 0.83

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.73

SHUTTLE SCHEDULE DELAY... 0.5

TOTAL SYSTEM MTF..... 36.0

VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30642216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	5367671.	142623226.
4	THERMAL	2120000.	2210971.
5	S-C MECHANISMS	3520000.	2721497.
6	ELECTRIC POWER	2548120.	64309792.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	14805196.	96122672.
9	PNEUMATICS	107058.	20781104.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2513000.	7114000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	131800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362926.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	30000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	103674752.	388476416.	
	G & A	13774017.	50113424.	1160999.
	SUBTOTAL	117048784.	438589696.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	131245792.	633453312.	10160999.

*NO G & A CHARGE

TOTAL

774859776.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

774859776.

NO. OF FAILURES.... 4.60

UPTIME (YEARS)..... 13.81

UPTIME RATIO..... 0.92

PERCOM PROGRAM

PROGRAM NO.74

SHUTTLE SCHEDULE DELAY... 1.0
 TOTAL SYSTEM MTF..... 36.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	5367671.	142623296.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721493.
6	ELECTRIC POWER	2548120.	64109792.
7	* PRIMARY OPTICS	3100000.	8000070.
8	COMM. & DATA HANDLING	14805196.	96122672.
9	PNEUMATICS	107058.	20781104.
10	TEST & SUPPORT EQUIPMENT	4669540.	2079614.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

9000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	103674752.	388476416.
G & A	13374037.	50113424.
SUBTOTAL	117048784.	438589696.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	131245792.	633451312.
*NO G & A CHARGE		10160999.

TOTAL

774859776.

0.0

774859776.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 4.54

UPTIME (YEARS)..... 13.62

UPTIME RATIO..... 0.91

PERCOM PROGRAM

PROGRAM NO.75

SHUTTLE SCHEDULE DELAY... 1.5
TOTAL SYSTEM MTF..... 36.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	5367671.	142623296.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	2548120.	64309792.
7	* PRIMARY OPTICS	3300000.	8000078.
8	COMM. & DATA HANDLING	14805196.	96122672.
9	PNEUMATICS	107058.	20781104.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7110000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4590000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	103674752.	308476416.	9000000.
	G & A	13374037.	50113424.	1160999.
	SUBTOTAL	117048784.	438590696.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	131245792.	633453312.	10160999.
	*NO G & A CHARGE			

TOTAL

774859776.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

774859776.

NO. OF FAILURES.... 4.48

UPTIME (YEARS).... 13.44

UPTIME RATIO..... 0.90

PERCOM PROGRAM

PROGRAM NO.76

SHUTTLE SCHEDULE DELAY... 2.0

TOTAL SYSTEM MTF..... 36.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	5367671.	142621296.
4	THERMAL	2120000.	2910071.
5	S-C MECHANISMS	7520000.	2721483.
6	ELECTRIC POWER	2548120.	64309792.
7 *	PRIMARY OPTICS	3700000.	8000878.
8	COMM. & DATA HANDLING	14805196.	96122672.
9	PNEUMATICS	107058.	20781104.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070674.
11	PROGRAM MANAGEMENT	2573000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16 *	TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19 *	EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21 *	NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22 *	LV-TITAN	0.0	22500000.
23 *	LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25 *	FACILITIES	1347012.	362826.
26 *	SHUTTLE UPDATE FLIGHT	0.0	15000000.
27 *	EXPERIMENT UPDATE	0.0	39000000.
28 *	G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

G & A CHARGEABLE	103674752.	388476416.	9000000.
G & A	13374037.	50113474.	1160999.
SURTOTAL	117048784.	438589696.	
NON-G & A SURTOTAL	14197012.	194867680.	
TOTAL	131245792.	633457312.	10160999.
*NO G & A CHARGE			

TOTAL

774859776.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

774859776.

NO. OF FAILURES.... 4.42

UPTIME (YFARS)..... 13.26

UPTIME RATIO..... 0.88

PERCOM PROGRAM

PROGRAM NO.77

SHUTTLE SCHEDULE DELAY.. 2.5
TOTAL SYSTEM MTF..... 36.0
VAR. SUBSYSTEM SLNDC..... 1.25

SHUTTLE-MAINTAINED PROGRAM (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	5167671.	142623226.
4	THERMAL	2120000.	2910271.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	2548120.	64109792.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	14805196.	96122672.
9	PNEUMATICS	107058.	20781104.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448690.
13	RELIABILITY	111600.	133000.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

G & A CHARGEABLE	103674752.	388476416.	9000000.
G & A	13374037.	50113424.	1160999.
SUBTOTAL	117048784.	438589696.	
NON-G & A SUBTOTAL	14197012.	194863690.	
TOTAL	131245792.	633453312.	10160999.
*NO G & A CHARGE			

TOTAL

774859776.

COST OF ADD'L SHUTTLE REPAIR FLYS

0.0

GRAND TOTAL

774859776.

NO. OF FAILURES.... 4.36

UPTIME (YEARS)..... 13.09

UPTIME RATIO..... 0.87

PERCOM PROGRAM

PROGRAM NO.78

SHUTTLE SCHEDULE DELAY... 3.0

TOTAL SYSTEM MTF..... 36.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	5367671.	142623296.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	2548120.	64304792.
7	* PRIMARY OPTICS	3300000.	8000879.
8	COMM. & DATA HANDLING	14805196.	96122672.
9	PNEUMATICS	107058.	20781104.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7117000.
12	SYSTEM INTEGRATION	944000.	2448678.
13	RELIABILITY	111600.	117800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

G & A CHARGEABLE	103674752.	388476416.	9000000.
G & A	13374037.	50113424.	1160999.
SUBTOTAL	117048784.	438589696.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	131245792.	633453312.	10160999.

*NO G & A CHARGE

TOTAL

774859776.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

774859776.

NO. OF FAILURES.... 4.31

UPTIME (YEARS)..... 12.92

UPTIME RATIO..... 0.86

PERCOM PROGRAM

PROGRAM NO.79

SHUTTLE SCHEDULE DELAY.....6.0

TOTAL SYSTEM MTF.....36.0

VAR. SUBSYSTEM SLOPE.....1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED NON-RECURRING RECURRING OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	5167671.	142623296.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721401.
6	ELECTRIC POWER	2548120.	64309792.
7	* PRIMARY OPTICS	1300000.	8000878.
8	COMM. & DATA HANDLING	14805196.	46122672.
9	PNEUMATICS	107058.	20781104.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2440698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	7251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	225000000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

G & A CHARGEABLE	103674752.	388476416.	9000000.
G & A	13374037.	50117424.	1160999.
SUBTOTAL	117048784.	438589696.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	131245792.	633453312.	10160999.
*NO G & A CHARGE			

TOTAL

774859776.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

774859776.

NO. OF FAILURES.... 4.00

UPTIME (YEARS)..... 12.00

UPTIME RATIO..... 0.80

PERCOM PROGRAM

PROGRAM NO.71

SHUTTLE SCHEDULE DELAY... 12.0

TOTAL SYSTEM MTF..... 24.0

VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2694125.	71585056.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	1278944.	32278160.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	7431007.	48245776.
9	PNEUMATICS	93735.	10430453.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	173800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	6790000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	8000000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	92304512.	227180288.
G & A	11907277.	29306240.
SUBTOTAL	104211776.	256486528.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	118408788.	451350208.
*NO G & A CHARGE		

TOTAL

579919616.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

579919616.

NO. OF FAILURES..... 4.67

UPTIME (YEARS)..... 9.33

UPTIME RATIO..... 0.62

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO.72

SHUTTLE SCHEDULE DELAY.. 24.0

TOTAL SYSTEM MTF..... 24.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	2694125.	71585056.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	1278944.	32278160.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	7431007.	48245776.
9	PNEUMATICS	53735.	10430453.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448608.
13	RELIABILITY	111600.	137800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	92304512.	227180288.	9000000.
	G & A	11907277.	29306240.	1160999.
	SUBTOTAL	104211776.	256486528.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	118408788.	451350208.	10160999.
	*NO G & A CHARGE			

TOTAL

579919616.

0.0

579919616.

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

NO. OF FAILURES.... 3.50

UPTIME (YEARS)..... 7.00

UPTIME RATIO..... 0.47

PERCOM PROGRAM

PROGRAM NO.80

SHUTTLE SCHEDULE DELAY.. 12.0
 TOTAL SYSTEM MTF..... 36.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30642216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	5367671.	142623296.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	2548120.	64102792.
7	* PRIMARY OPTICS	7300000.	8000878.
8	COMM. & DATA HANDLING	14805196.	96122672.
9	PNEUMATICS	107058.	20781104.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	79000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	762826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	79000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	103674752.	388476416.	90000000.
	G & A	17374037.	50113424.	1160999.
	SUBTOTAL	117048784.	438589696.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	131245792.	633453312.	10160999.
	*NO G & A CHARGE			

TOTAL

774859776.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

774859776.

NO. OF FAILURES.... 3.50

UPTIME (YEARS)..... 10.50

UPTIME RATIO..... 0.70

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO. 81

SHUTTLE SCHEDULE DELAY.. 24.0
 TOTAL SYSTEM MTF..... 36.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	5367671.	142623206.
4	THERMAL	2120000.	2910271.
5	S-C MECHANISMS	3520000.	2721493.
6	ELECTRIC POWER	2549120.	64309722.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	14805196.	96122672.
9	PNEUMATICS	107058.	20781104.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1947000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	103674752.	388476416.
G & A	13374017.	50113424.
SUBTOTAL	117048784.	438589696.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	131245792.	633453312.
*NO G & A CHARGE		10160999.

TOTAL

774859776.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

774859776.

NO. OF FAILURES.... 2.80

UPTIME (YEARS)..... 8.40

UPTIME RATIO..... 0.56

PERCOM PROGRAM

PROGRAM NO. 82

SHUTTLE SCHEDULE DELAY.. 0.5
 TOTAL SYSTEM MTF..... 48.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	8562705.	227517872.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	4064853.	102589312.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	23617648.	153337520.
9	PNEUMATICS	170783.	33150784.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2531000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448679.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	6700000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	390000000.
20	GROUND STATION	3251000.	8000000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	225000000.
23	* LV-SHUTTLE	0.0	100000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	390000000.
28	* G.S.F.C. & OTHER	0.0	600000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	117262704.	591234688.	90000000.
	G & A	15126882.	74979232.	1160999.
	SUBTOTAL	132389584.	656213760.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	146586592.	851077376.	10160999.
	*NO G & A CHARGE			

TOTAL

1007824640.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

1007824640.

NO. OF FAILURES.... 3.46

UPTIME (YEARS)..... 13.86

UPTIME RATIO..... 0.92

PERCOM PROGRAM

PROGRAM NO.03

SHUTTLE SCHEDULE DELAY.. 1.0
TOTAL SYSTEM MTF..... 49.0
VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30640216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	8562705.	227517872.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721481.
6	ELECTRIC POWER	4064853.	102599112.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	23617648.	153317520.
9	PNEUMATICS	170783.	31150784.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	133900.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

90000000.

ORBITAL OPERATIONS

29	G & A CHARGFABLE	117262704.	581234688.
	G & A	15126882.	74979212.
	SUBTOTAL	132389584.	656213760.
	NON-G & A SUBTOTAL	14197012.	194863680.
	TOTAL	146586592.	851077376.

10160999.

*NO G & A CHARGE

TOTAL

1007824640.

0.0

COST OF ADD'L SHUTTLE REPAIR FLTS

1007824640.

GRAND TOTAL

NO. OF FAILURES.... 3.43

UPTIME (YEARS)..... 13.71

UPTIME RATIO..... 0.91

PERCOM PROGRAM

PROGRAM NO.84

SHUTTLE SCHEDULE DELAY.. 1.5
 TOTAL SYSTEM MTTF..... 48.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	8562705.	227517872.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	4064853.	102580312.
7	* PRIMARY OPTICS	3300000.	8000978.
8	COMM. & DATA HANDLING	23617648.	153117520.
9	PNEUMATICS	170783.	33150784.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448699.
13	RELIABILITY	111600.	113800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1977000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	117262704.	501234688.
G & A	15126882.	74979232.
SUBTOTAL	132389584.	656213760.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	146586592.	851077376.
*NO G & A CHARGE		10160999.

TOTAL

1007824640.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

1007824640.

NO. OF FAILURES.... 3.39

UPTIME (YEARS).... 13.58

UPTIME RATIO..... 0.91

PERCOM PROGRAM

PROGRAM NO.85

SHUTTLE SCHEDULE DELAY.. 2.0
 TOTAL SYSTEM MTF..... 48.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	8562705.	227517872.
4	THERMAL	2120000.	2910271.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	4064853.	102589312.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	23617648.	153317520.
9	PNEUMATICS	170783.	33150784.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	113800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	117262704.	581234688.	
G & A	15126882.	74979232.	1160999.
SUBTOTAL	132389584.	656213760.	
NON-G & A SUBTOTAL	14197012.	194863680.	
TOTAL	146586592.	851077376.	10160999.
*NO G & A CHARGE			

TOTAL

1007824640.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

1007824640.

NO. OF FAILURES.... 3.36

UPTIME (YEARS)..... 13.44

UPTIME RATIO..... 0.90

PERCOM PROGRAM

PROGRAM NO. 86

SHUTTLE SCHEDULE DELAY... 2.5

TOTAL SYSTEM MTTF..... 48.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	8562705.	227517872.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	4064853.	102589112.
7	* PRIMARY OPTICS	3100000.	8000878.
8	COMM. & DATA HANDLING	23617648.	151117520.
9	PNEUMATICS	170783.	31150784.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2511000.	7112000.
12	SYSTEM INTEGRATION	944000.	2448628.
13	RELIABILITY	111600.	113800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	117262704.	581234680.	9000000.
	G & A	15126882.	74279232.	1160999.
	SUBTOTAL	132389584.	656213760.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	146586592.	851077376.	10160999.

*NO G & A CHARGE

TOTAL

1007824640.

0.0

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

1007824640.

NO. OF FAILURES.... 3.33

UPTIME (YEARS).... 13.31

UPTIME RATIO..... 0.89

NOT REPRODUCIBLE

PFRCOM PROGRAM

PROGRAM NO.87

SHUTTLE SCHEDULE DELAY, 3.0

TOTAL SYSTEM MTIF..... 48.0

VAR, SUBSYSTEM SLOPE, 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30647216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	8562705.	227517872.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721491.
6	ELECTRIC POWER	4064853.	102589312.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	23617648.	153317520.
9	PNEUMATICS	170783.	31150784.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGEABLE	117262704.	581234688.	9000000.
	G & A	15126882.	74979232.	1160999.
	SUBTOTAL	132389584.	656213760.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	146586592.	851077376.	10160999.
	*ND G & A CHARGE			

TOTAL

1007824640.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

1007824640.

NO. OF FAILURES.... 3.29

UPTIME (YEARS).... 13.18

UPTIME RATIO..... 0.88

195

PERCOM PROGRAM

PROGRAM NO. 88

SHUTTLE SCHEDULE DELAY... 6.0
 TOTAL SYSTEM MTTF..... 48.0
 VAR. SUBSYSTEM SLOPE..... 1.25

SHUTTLE-MAINTAINED PROGRAM

(3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	8562705.	227517872.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	4054851.	102589312.
7	* PRIMARY OPTICS	3300000.	8000878.
8	COMM. & DATA HANDLING	23617648.	151317520.
9	PNEUMATICS	170783.	33150784.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2531000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448898.
13	RELIABILITY	111600.	111000.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000008.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	762826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

ORBITAL OPERATIONS

29	G & A CHARGABLE	117262704.	581234688.	90000000.
	G & A	15126882.	74979232.	1160999.
	SUBTOTAL	132389584.	656211760.	
	NON-G & A SUBTOTAL	14197012.	194863680.	
	TOTAL	146586592.	851077376.	10160999.
	*NO G & A CHARGE			

TOTAL

1007824640.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

1007824640.

NO. OF FAILURES.... 3.11

UPTIME (YEARS)..... 12.44

UPTIME RATIO..... 0.83

NOT REPRODUCIBLE

PERCOM PROGRAM

PROGRAM NO. 89

SHUTTLE SCHEDULE DELAY.. 12.0

TOTAL SYSTEM MTTF..... 48.0

VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
(7 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	30649210.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	8562703.	227517872.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721443.
6	ELECTRIC POWER	4064853.	102589312.
7	* PRIMARY OPTICS	3700000.	8000878.
8	COMM. & DATA HANDLING	23617648.	151117520.
9	PNEUMATICS	178783.	31150784.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070614.
11	PROGRAM MANAGEMENT	2513000.	7119000.
12	SYSTEM INTEGRATION	944000.	2448604.
13	RELIABILITY	111600.	131900.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1997000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362876.
26	* SHUTTLE UPDATE FLIGHT	0.0	1500000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	117262704.	591234688.
G & A	15126882.	74979232.
SUBTOTAL	132189584.	666213760.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	146586592.	851077440.
*NO G & A CHARGE		10160999.

TOTAL

1007824640.

COST OF ADD'L SHUTTLE REPAIR FLTS

0.0

GRAND TOTAL

1007824640.

NO. OF FAILURES.... 2.80

UPTIME (YEARS)..... 11.20

UPTIME RATIO..... 0.75

197

PERCOM PROGRAM

PROGRAM NO.90

SHUTTLE SCHEDULE DELAY.. 24.0
 TOTAL SYSTEM MTTF..... 48.0
 VAR. SUBSYSTEM SLOPE.... 1.25

SHUTTLE-MAINTAINED PROGRAM
 (3 SPACECRAFT)-NOT OPTIMIZED

NON-RECURRING

RECURRING

OPERATIONS

1	STRUCTURE	20150000.	10649216.
2	ENGINEERING	17500000.	2250126.
3	STABILIZATION	8562705.	227517872.
4	THERMAL	2120000.	2910971.
5	S-C MECHANISMS	3520000.	2721483.
6	ELECTRIC POWER	4064853.	102589312.
7	* PRIMARY OPTICS	3100000.	8000878.
8	COMM. & DATA HANDLING	23617648.	151337520.
9	PNEUMATICS	170783.	33150784.
10	TEST & SUPPORT EQUIPMENT	4669540.	2070634.
11	PROGRAM MANAGEMENT	2533000.	7119000.
12	SYSTEM INTEGRATION	944000.	2449698.
13	RELIABILITY	111600.	133800.
14	QUALITY ACCEPTANCE	1445220.	5820000.
15	TITAN INTERSTAGE	582000.	670000.
16	* TITAN SHROUD	0.0	1000000.
17	SHUTTLE INTERFACES	20910000.	1927000.
18	TRAINERS & SIMULATORS	3110400.	100000.
19	* EXPERIMENTS A & B	5000000.	39000000.
20	GROUND STATION	3251000.	800000.
21	* NEW COMPUTERS	4550000.	0.0

LAUNCH OPERATIONS

22	* LV-TITAN	0.0	22500000.
23	* LV-SHUTTLE	0.0	10000000.
24	S-C SUPPORT	0.0	4950000.
25	* FACILITIES	1347012.	362826.
26	* SHUTTLE UPDATE FLIGHT	0.0	15000000.
27	* EXPERIMENT UPDATE	0.0	39000000.
28	* G.S.F.C. & OTHER	0.0	60000000.

29 ORBITAL OPERATIONS

9000000.

G & A CHARGEABLE	117262704.	581234688.
G & A	15126882.	74979232.
SUBTOTAL	132389584.	656211760.
NON-G & A SUBTOTAL	14197012.	194863680.
TOTAL	146586592.	851077376.
*NO G & A CHARGE		10160999.

TOTAL

1007824640.

0.0

COST OF ADD'L SHUTTLE REPAIR FLTS

GRAND TOTAL

1007824640.

NO. OF FAILURES.... 2.33

UPTIME (YEARS)..... 9.33

UPTIME RATIO..... 0.62

NOT REPRODUCIBLE